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Estimates of shorebird populations in North America

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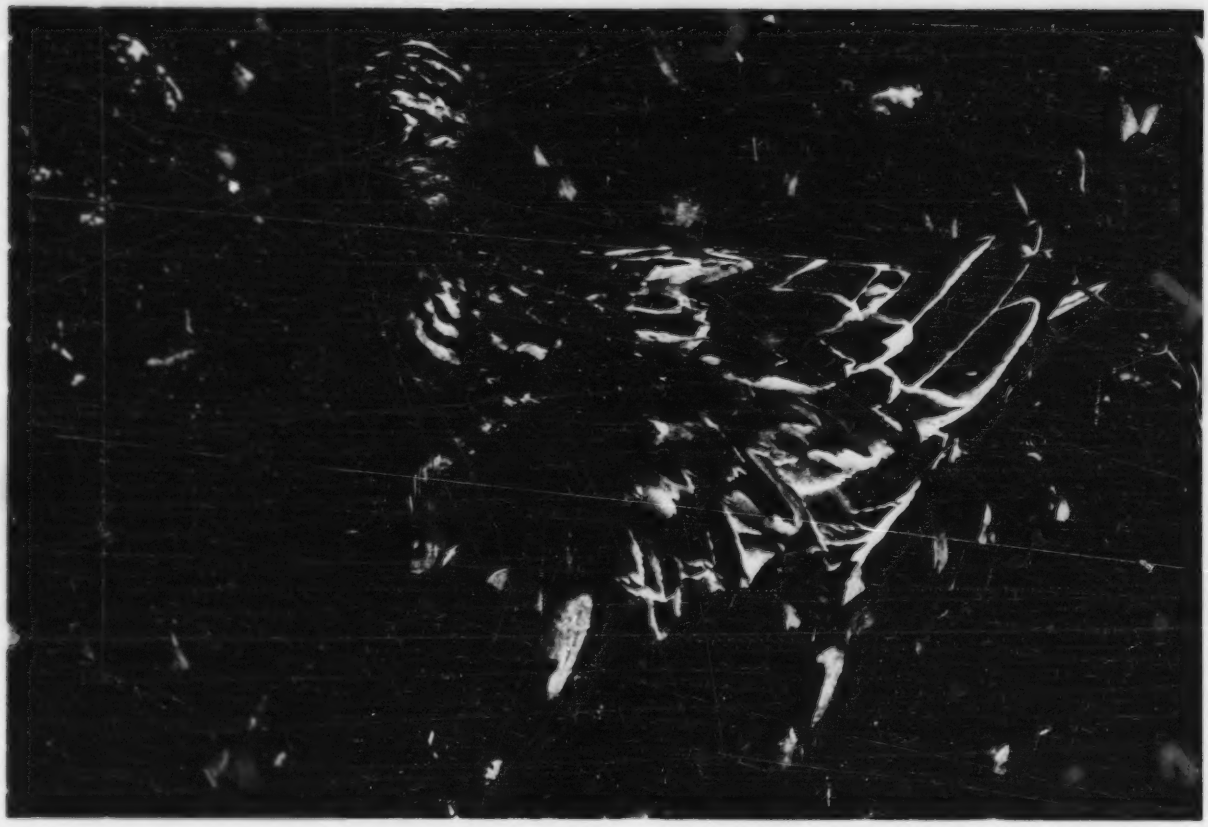
Canadian Wildlife Service



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Abstract

Estimates are presented for the population sizes of 53 species of Nearctic shorebirds occurring regularly in North America, plus four species that breed occasionally. Population estimates range from a few tens to several millions. Overall, population estimates most commonly fall in the range of hundreds of thousands, particularly the low hundreds of thousands; estimated population sizes for large shorebird species currently all fall below 500 000. Population size is inversely related to size (mass) of the species, with a statistically significant negative regression between log(population size) and log(mass). Two outlying groups are evident on the regression graph: one, with populations lower than predicted, includes species considered to be either "at risk" or particularly hard to count, and a second, with populations higher than predicted, includes two species that are hunted. Shorebird population sizes were derived from data obtained by a variety of methods from breeding, migration, and wintering areas, and formal assessments of accuracy of counts or estimates are rarely available. Accurate estimates exist only for a few species that have been the subject of detailed investigation, and the likely accuracy of most estimates is considered poor or low. Population estimates are an integral part of conservation plans being developed for shorebirds in the United States and Canada and may be used to identify areas of key international and regional importance.

Résumé

Des estimations sont présentées pour les tailles des populations de 53 espèces d'oiseaux de rivage néarctiques que l'on trouve régulièrement en Amérique du Nord, en plus de quatre espèces qui s'y reproduisent parfois. Les estimations des populations varient de quelques dizaines à plusieurs millions. Globalement, les estimations des populations se situent généralement dans les centaines de milliers, notamment les quelques centaines de milliers; les tailles estimées des populations pour les espèces de gros oiseaux de rivage se situent actuellement toutes sous les 500 000 individus. La taille de la population est en relation inverse au poids (masse) de l'espèce, comportant une régression négative statistiquement significative entre l'inscription (taille de la population) et l'inscription (masse). Deux groupes éloignés sont évidents dans le graphique de régression : le premier, comportant de plus faibles populations que prévues, comprend des espèces considérées soit « en péril » ou particulièrement difficiles à dénombrer, et le second, comportant des populations plus abondantes que prévues, comprend deux espèces qui sont chassées. Les tailles des populations des oiseaux de rivage ont été calculées à partir des données obtenues par une gamme de méthodes provenant des aires de nidification, de migration et d'hivernage; les évaluations officielles de l'exactitude des dénombrements ou des estimations sont rarement disponibles. Des estimations exactes existent seulement pour quelques espèces qui ont fait l'objet de relevés détaillés, et l'exactitude probable de la plupart des estimations est considérée faible ou basse. Les estimations des populations sont une partie intégrante des plans de conservation en voie d'élaboration pour les oiseaux de rivage aux États-Unis et au Canada et elles peuvent servir à cerner les régions d'importance primaire internationale et régionale.

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1. Introduction

Knowledge of the number of animals in a population not only is of intrinsic biological interest, but, for shorebirds and other waterbirds, has also assumed considerable practical application in conservation planning and action. Population estimates have been used, for instance, in assessing the importance of sites and habitats for protection and for setting targets for the recovery of endangered species or for the maintenance of populations at desired levels. Two major tools used for the conservation of wetlands and waterbird populations in the Western Hemisphere use criteria involving percentages of flyway populations of waterbirds using the site to determine its potential importance; these are the Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention), and the Western Hemisphere Shorebird Reserve Network (WHSRN) (Morrison et al. 1995; Frazier 1996; Rose and Scott 1997; MCCS 1999). For Ramsar sites, an area can be identified as a wetland of international importance if it regularly supports 1% of a species or subspecies of waterfowl, and this criterion has been widely used in identifying wetlands for conservation and protection (Frazier 1996; Rose and Scott 1997). For WHSRN, three levels of importance have been recognized for site designation, depending on whether it supports more than 5% (Regional), 15% (International), or 30% (Hemispheric) of a flyway population of shorebirds (Morrison et al. 1995; MCCS 1999). In addition, similar criteria have been adopted by the Important Bird Areas (IBA) program of BirdLife International, launched in Canada in 1996 in partnership with the Canadian Nature Federation and Bird Studies Canada (IBA 1998). Application of these criteria clearly requires a knowledge of the population sizes of the species being considered.

For endangered species, knowledge of population size is necessary to assess the status of the species as well as to provide a criterion or target against which the success of management efforts may be measured (e.g., for Piping Plover [for scientific names of species, refer to Table 1]; Goosen et al. 1997). Target population levels were adopted for waterfowl to measure the success of conservation initiatives undertaken through the North American Waterfowl Management Plan. Shorebird Conservation Plans being developed in Canada and the United States also require knowledge of shorebird population levels and trends to assess their success. Knowledge of population size and status is also needed to support a variety of other conservation efforts, including maintaining global diversity under the Convention on Biological Diversity, signed by many nations in Rio de Janeiro in 1992, protocols such as the Agreement on the Conservation of African-Eurasian Migratory Waterbirds under the Bonn Convention, and the East Asian Australasian Shorebird Reserve Network.

On a practical level, the estimation of population sizes of shorebirds is fraught with many difficulties. Many Nearctic species migrate from breeding grounds in the North American Arctic and sub-Arctic, where they are found dispersed at low densities over vast areas, through migration areas, where they may occur in large but highly variable numbers, to wintering areas, some of which occur in remote areas as far south as Tierra del Fuego at the southern tip of South America (Morrison 1984; Morrison and Ross 1989). Attempting to count or otherwise determine the numbers of birds occurring at any one of these stages brings with it a different set of problems relating to logistics, methodology, adequacy of geographic coverage, accuracy and biases of estimates obtained, and the life history characteristics of the species being studied.

These difficulties apply to assessing shorebird numbers for flyways in most parts of the world (see flyway review papers in Davidson and Pienkowski [1987]), and it is only within the past 20 years that enough information has been obtained to allow the question of shorebird population sizes to be addressed. In Europe, many shorebirds using the East Atlantic Flyway winter in or pass through areas near human populations, and a combination of internationally coordinated ground counts by networks of observers in Europe and by expeditions to more remote areas in west Africa enabled estimates of numbers occurring on this flyway to be assembled by Smit and Piersma (1989).

In the Western Hemisphere, although anecdotal accounts of large numbers of shorebirds at various places in their migration ranges have been known for many years (see accounts in Bent [1927, 1929]), coordinated information over wide geographical areas started to become available only after the mid-1970s, when observer networks were set up in Canada and the United States to count shorebirds during migration periods (Morrison 1983). Initial efforts were mainly in eastern Canada and the United States, and data from these programs (the Maritimes Shorebird Survey [MSS] and International Shorebird Survey [ISS], respectively) have been used to identify potential WHSRN sites in Canada (Morrison et al. 1995) and the United States (Harrington and Perry 1995), as well as to assess shorebird population trends (Howe et al. 1989; Morrison et al. 1994b). Extensive compilations of data are now also available from the interior of the United States and Canada (the Interior Flyway: Skagen et al. 1999), as well as for western and Pacific areas of the United States and Canada (the Pacific Flyway: Page et al. 1992; Page and Gill 1994), including Alaska (Gill et al. 1999; R.E. Gill, unpubl. data). Aerial surveys have been used to cover large and/or remote areas, such as James Bay (Morrison and Harrington 1979), Hudson Bay (Morrison and Harrington 1979), and Delaware Bay (Clark et al. 1993); they have been especially useful on the wintering grounds, where "Atlas" projects have covered large geographical areas, including South America (Morrison and Ross 1989), Panama (Morrison et al. 1998), and Mexico (Morrison et al. 1992, 1993, 1994c).

Page and Gill (1994) reviewed information on shorebird populations in western North America, and some preliminary estimates for numbers occurring in Canada were presented by Morrison et al. (1994a), although in many cases these represented a best "guesstimate" or an assignment to the most likely order of magnitude. The present report attempts to bring together as much information as possible from breeding, migration, and wintering areas to update our current knowledge of the size of Western Hemisphere shorebird populations; this has led to considerable modification of the estimates for many species. The report covers 57 species of shorebirds occurring in Canada and the United States, including Hawaii, 47 of which are considered to occur regularly and/or to be "at risk" in Canada (Morrison et al. 1994a, and unpubl. data).

2. Methods

Data sources

The data used in assembling population estimates have been taken mostly from major regional compilations, with some additions from other published and unpublished material, as described below and in the species accounts. Material from publications on individual sites within the major regions has also been examined and used to adjust totals from regional compilations where appropriate, although this literature review has not been exhaustive. Much of the data has been compiled on a regional or geographical basis into broadly defined flyways. On an individual species basis, a flyway may be considered as the migration route(s) and areas used by a shorebird population in moving between its breeding and wintering grounds (Davidson and Pienkowski 1987), and in a more general sense as a distinguishable pattern of migration routes used by a group of related species (Piersma et al. 1987). In North America, three major shorebird flyways are considered to exist: (1) the Pacific Flyway, involving routes along the Pacific coast of North America (Mexico, the United States, including Alaska, and Canada) and associated western areas, including the Central Valley of California; (2) the Interior Flyway, involving all interior parts of the continent (this would include the Central Flyway and the Mississippi Flyway used in waterfowl terminology; Lincoln 1952); and (3) the Eastern Flyway, involving routes passing up and down the Atlantic coast of the United States and Canada and involving interior areas in the eastern part of the continent between the Atlantic coast and approximately James Bay.

Principal data sources are as follows:

- *Canada:* Data from the MSS, which covers the Atlantic provinces of Canada (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland), were analyzed to extract the maximum count of each species at each site covered during fall and spring surveys for the years 1974–1991. Maximum counts were summed to produce a regional total for each species. Data compiled in Morrison et al. (1995) to document potential WHSRN sites in Canada were used for other parts of Canada. Additional information came from aerial and ground surveys carried out by the Canadian Wildlife Service (CWS) in James Bay and Hudson Bay and along the St. Lawrence River estuary (Morrison and Harrington 1979; Brousseau 1981; Maisonneuve 1982; Maisonneuve et al. 1990).
- *United States:* Data from the ISS for the years 1971–1998 were analyzed in a manner similar to that described above for the MSS data to produce totals for Pacific (Utah, Nevada, Arizona, California, Idaho, Washington, and Oregon), interior (Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, Montana, Wyoming, Colorado, Oklahoma, Arkansas, Texas, Louisiana, and New Mexico), and eastern (Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, Pennsylvania, New Jersey, Maryland, Delaware, Michigan, Ohio, West Virginia, Virginia, North Carolina, South Carolina, Wisconsin, Illinois, Indiana, Kentucky, Tennessee, Mississippi, Alabama, Georgia, and Florida) regions of the United States for

both spring and fall migration periods. In addition, maximum count totals were extracted for the same regions from data compiled by Harrington and Perry (1995) to document potential WHSRN sites in the United States. Regional compilations of data produced by Harrington and Page (1992), covering areas in the three above regions, including sites in Canada, were also consulted. Clark et al. (1993) provided multiyear aerial survey data from Delaware Bay.

For the Interior Flyway, the major compilation of data by Skagen et al. (1999), covering sites in the central United States and Canada, provided the most extensive summary of counts from this region currently available.

For the Pacific Flyway, Page et al. (1992) provided a summary of counts from the west coast and western interior wetlands, including the United States, Baja California, and parts of Canada. Page and Gill (1994) reviewed population estimates for some species occurring in western North America. For the present analysis, updated population estimates have been compiled (G.W. Page, unpubl. data) for "western North America" (see also Page et al. 1999), comprising the ISS "Pacific" states plus New Mexico and including Baja California. In some cases, counts by Skagen et al. (1999) included counts from these states; these counts were subtracted from Interior Flyway totals where overlap occurred to eliminate duplication. Where totals for wintering populations in "western North America" were used, counts in Mexico (see below) were adjusted so that there would not be duplication of Baja California counts.

- *Canadian Arctic:* Although estimates of breeding shorebird densities have been made for a fairly large number of sites in the Arctic, estimates of populations occurring over wider geographical regions are less common. The current Arctic estimates have been derived from early exploratory avifaunal surveys, environmental impact assessment surveys, and, more recently, extrapolations based on remote sensing studies; this material has been reviewed in Morrison (1997).
- *Alaska:* Data were compiled from information on potential WHSRN sites in Alaska (Gill et al. 1999), as well as other literature sources (e.g., Islieb and Kessel 1973; Islieb 1979; Gill and Handel 1990; Gill and McCaffery 1999) mentioned in the species accounts.
- *Mexico:* Data from the CWS "Atlas" project provided information on wintering numbers of shorebirds on both coasts of Mexico (Morrison et al. 1992, 1993, 1994c). Several other studies have provided comparative data, especially from the Pacific northwest and Baja California regions of Mexico (Harrington 1993a,b, 1994; Page and Palacios 1993; Page et al. 1997; Engilis et al. 1998).
- *Central America and the Caribbean:* Apart from Panama, where CWS "Atlas" and other aerial surveys (Morrison et al. 1998; Watts et al. 1998) have provided information on key migration and wintering areas, few quantitative data are available, although wetland inventories of the area have been carried out (Scott and Carbonell 1986).
- *South America:* CWS "Atlas" surveys of wintering populations provide extensive coverage of key coastal sites in South America (Morrison and Ross 1989), whereas additional material is provided for interior and coastal areas in the extensive wetland inventory conducted by Scott and Carbonell (1986) and in a summary updating distributional information by Blanco and Canevari (1998).
- *Population estimates using Breeding Bird Survey (BBS) data:* Although the most common use of BBS data is for assessing population trends, it is theoretically possible to make an estimate of breeding population numbers from BBS data for those shorebird species whose ranges occur in areas covered by the BBS. BBS routes involve coverage of a known area (each route consists of 50 stops, each stop covering a nonoverlapping area of radius 0.4 km [one quarter mile]) in a known landscape type or physiographic stratum.

The mean density of the species in each physiographic stratum may be derived from the routes occurring in that stratum, and a population estimate for the stratum may be obtained based on the total area of the stratum. Summing the numbers occurring in all the strata produces an overall population estimate. There are many potential sources of bias and error using this approach, however, and it is probably useful for only a few, if any, shorebird species. Population estimates for shorebird species covered by the BBS have been included in the text for comparative purposes, but they are not generally used where they are clearly divergent from estimates obtained by other methods.

Data compilation

The procedure used in assembling the numbers presented in the species accounts below is as follows. First, data were tabulated separately for each species and for each of the following "seasons": breeding, northward migration, southward migration, and wintering. Data were then compiled for major regions (e.g., Mexico, Pacific Flyway, Interior Flyway, Eastern Flyway [United States and Canada], Alaska, etc.), and maximum count totals were extracted for each species for that region. Data from publications on specific sites within a region were in some cases compared with the totals for those sites in regional summary publications and substituted for those totals if larger, although this type of comparison has not been exhaustive. Counts for Alaska were in some cases considered separately, where it was judged that birds counted at migration sites in Alaska would also have been counted in another geographical region within the same season; in such cases, the larger regional total was used in assessing overall population size. Overall totals were then produced for all regions for a given season, and the largest seasonal total was taken to indicate at least a minimum likely population for that species. How these seasonal totals are used to assess an estimated overall population size is discussed in each species account.

In general, we have attempted to be conservative in our assessment of population sizes. Where counts derived from observable numbers of birds differ considerably from those obtained using extrapolations, we have usually adopted the smaller estimate, particularly in cases where the species may be considered "at risk" and where the extrapolation was obtained from BBS data. More quantitative approaches from Arctic breeding areas, where extrapolations have been based on surveys and associated remote sensing data that provide an estimate of areas of suitable habitat, may provide useful perspectives on population numbers and are discussed in the species accounts as appropriate.

Use of maximum counts

Maximum counts were chosen as the most practicable number for use in estimating overall populations. The maximum count provides at least a minimum estimate of the number of birds occurring in an area: total numbers will clearly be larger, as there is considerable turnover (which varies in different geographical regions) as birds move through a site, and often adults and juveniles move through a site at different times during southward migration. On the other hand, maximum counts may be unrepresentative — for instance, in cases where an exceptionally large number of birds may be found in a site for a brief period following unusual weather events (Morrison et al. 1994b). Movement of birds between sites gives rise to the possibility that they may be counted multiple times. This source of error is most likely to arise during migration periods, as most populations are thought to be relatively stable or sedentary during breeding and wintering seasons. It is also difficult to assess, as it is likely to vary with the species being counted and the region being considered. For instance, Western Sandpipers are liable to use a number of Pacific coast stopover areas during northward migration in a manner dependent on weather conditions (Iverson et al. 1996; Warnock and Bishop 1998), whereas studies in other areas have shown that some species are highly site-faithful from year to year and probably do not move a great deal on a regional scale within a single season.

It is also unlikely that all sites used by shorebirds will be covered during survey operations. Where aerial surveys have been used to determine shorebird numbers over large areas, as in the CWS "Atlas" projects (see above), flights will provide only a single "snapshot" of the birds present, and numbers are usually underestimated for a variety of reasons, including counting errors, weather and tidal conditions (in coastal areas), and areas not covered during the flights. Overall, these considerations indicate that nearly all estimates of numbers derived from either ground or aerial counts are likely to be underestimates.

Seasonal considerations

In addition to the phenological considerations mentioned above, there are a number of other factors relating to shorebird biology that are liable to influence counts obtained during different periods of the year. Estimates based on numbers of nesting pairs on the breeding grounds clearly do not include nonbreeding segments of the population, including subadult and other birds that may spend the summer south of the breeding grounds and birds that have reached the breeding areas but do not nest. During the southward migration, numbers are likely to be at their highest, as both adults and juveniles hatched that summer will be present, resulting in a population that could be perhaps double that at the beginning of the nesting season. Mortality during the fall migration and subsequent winter will lead to lower numbers during the following northward migration. These considerations may not necessarily be reflected in counts obtained in the field; for instance, counts will be higher for a species that is highly concentrated during spring migration and relatively easily counted than for one that is more highly dispersed in space and time during the fall migration. These points serve to emphasize the difficulties faced in assessing population numbers at different times of the year.

Assessing the accuracy of population estimates

The accuracies of estimates obtained for different species are likely to vary considerably, as the methods used range from dedicated counts directed at a particular species (e.g., Piping Plover) to cases where almost no information is available and the estimate is essentially an educated guess. We have attempted to rate the accuracy of the estimate for each species to give some indication of the reliability of the number presented. In almost no cases were data available to present a statistically based estimate of the standard deviation or error of the estimate, and the ranges shown are intended to illustrate the likely range of uncertainty. Accuracy scores were assigned as follows:

- 1 (Poor): A population estimate based on an educated guess. Score 1 was also given to Eskimo Curlew, which has not been reliably seen in recent years.
- 2 (Low): A population estimate based on broad-scale surveys where estimated population size is likely to be in the right order of magnitude.
- 3 (Moderate): A population estimate based on a special survey or on broad-scale surveys of a narrowly distributed species whose populations tend to concentrate to a high degree either in a restricted habitat or at a small number of favoured sites. Estimate thought to be within 50% of the true number.
- 4 (Good): A calculated estimate based on broad-scale mark:recapture ratios or other systematic estimating effort resulting in estimates on which confidence limits can be placed.
- 5 (High): Number obtained from a dedicated census effort and thought to be accurate and precise. Sometimes an indication of the probable percentage accuracy is given, or at least a minimum population figure derived from the data.

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Data presentation

Data for each species are summarized in a table at the top of the species account, and for all species together in Table 1. Estimates are given for the global population, if available, taken mainly from Rose and Scott (1997) and adjusted if necessary because of revisions made to Western Hemisphere population estimates. Numbers are also provided for Neotropical (South America, Central America, and Caribbean), North American (includes Canada, United States [including Alaska and Hawaii], and Mexico), and Canadian populations. These are often the same, but they may differ in cases where, for example, Canadian or Alaskan breeding grounds support populations that migrate to areas outside the Western Hemisphere (Europe, Australasia, etc.), so that Canadian/North American populations are larger than Neotropical ones; or where portions of breeding ranges occur south of Canada, so that the Canadian population will be smaller than the North American(/Neotropical) one. The numbers represent individuals (all ages). Numbers for a given region include birds if they are likely to occur in the region at any stage of their life cycle; for example, birds breeding in Alaska and wintering in the Western Hemisphere are likely to pass through Canada on migration, so they are included in the Canadian total. Neotropical population size will be the same as the North American one where a species entirely breeds within or passes through North America on migration and winters entirely in the Neotropics; it may be larger where the species also breeds within the Neotropical region. Where a population winters in both North America and the Neotropics and the proportion occurring in both areas is not known, the Neotropical population estimate is generally left blank. These numbers are all the most likely population estimate based on combinations of the data currently available.

In contrast, the flyway totals (Pacific, Interior, Eastern) are based on the largest currently observed combination of maximum counts that has been recorded in each of those flyways, whenever those counts have occurred (i.e., during northward or southward migration, breeding, or wintering); they are not likely, therefore, to approach overall totals, as more comprehensive data may be available in other regions at other times of the year (e.g., on breeding or wintering areas) for the species.

In addition, information is presented on the percentage of the breeding range that is thought to occur in Canada (E. Dunn, pers. commun.), as well as breeding status in Canada and abundance status in Canada (Morrison et al. 1994a, and unpubl. data).

3. Species accounts

Guide to information in population tables in species accounts[a]

Code	Population estimates: Global	Neotropical	North America	Canada	% North American range in Canada	Current maximum count totals: Pacific Flyway	Interior Flyway	Eastern Flyway	Breeding status (Canada)	Abundance status (Canada)
4-letter AOU[b] species alpha code	**Estimated population figures** for (1) Global (Rose and Scott 1997, adjusted for present estimates); (2) Neotropical region = Central America, Caribbean, and South America; (3) North America = Canada, United States (including Alaska), and Mexico (Greenland not included); and (4) Canada				% of North American range estimated to occur in Canada (E. Dunn, unpubl. data)	**Current maximum count totals observed in each flyway** — these *do not* represent the *estimated total* numbers of birds using the flyway but the *currently observed maximum count totals* from the flyway, at whichever season they have been recorded; in other words, it is not a flyway population estimate, but an indication of the maximum observable number in the flyway			Based on Morrison et al. (1994a); B = breeds	Based on Morrison et al. (1994a); Acc = accidental; Cas = casual; Com = common; End = endangered; Rar = rare; Reg = regular; Sca = scarce; Thr = threatened; Unc = uncommon; Vul = vulnerable

[a] Shading indicates that the species is "at risk" (i.e., endangered, threatened, vulnerable).
[b] American Ornithologists' Union.

Black-bellied Plover *Pluvialis squatarola*

Code	Population estimates: Global	Neotropical	North America	Canada	% North American range in Canada	Current maximum count totals: Pacific Flyway	Interior Flyway	Eastern Flyway	Breeding status (Canada)	Abundance status (Canada)
BBPL	498 000		200 000	200 000		52 100	33 100	75 200	B	Com

Rose and Scott (1997) listed five populations globally, with estimates totalling 348 000 birds. Two populations occur in North America: *P. s. squatarola*, breeding in Alaska and wintering along the Pacific Flyway, and *P. s. cynosurae*, breeding in northern Canada and wintering on the Atlantic and Gulf coasts and areas south (Paulson 1995; Engelmoer and Roselaar 1998). The global estimate should be revised to 348 000 minus 50 000 (previous North American estimate) plus 200 000 (current North American estimate; see below) = 498 000.

The previous North American estimate of 50 000 (Morrison et al. 1994a), used by Rose and Scott (1997), would appear to be too low, based on estimates of numbers of the two subspecies from the breeding grounds, wintering areas, and migration areas. Estimates of breeding populations from six areas of the Canadian Arctic covering some 123 940 km^2 produced a total of almost 140 000 (139 555) birds (Morrison 1997), indicating that the overall population (involving only *P. s. cynosurae*) is likely to exceed 150 000. Counts from fall migration areas are as follows: eastern USA 61 400 (ISS), eastern Canada 13 800 (MSS), Interior Flyway 12 000 (Skagen et al. 1999), and Pacific Flyway 18 000 (Page et al. 1992), totalling 105 200. Spring numbers include eastern USA 26 900 (ISS), Interior Flyway 33 100 (Skagen et al. 1999), and Pacific USA 12 000 (ISS), totalling 72 000.

3. Species accounts

Guide to information in population tables in species accounts[a]

Code	Population estimates: Global	Neotropical	North America	Canada	% North American range in Canada	Current maximum count totals: Pacific Flyway	Interior Flyway	Eastern Flyway	Breeding status (Canada)	Abundance status (Canada)
4-letter AOU[b] species alpha code	**Estimated population figures** for (1) Global (Rose and Scott 1997, adjusted for present estimates); (2) Neotropical region = Central America, Caribbean, and South America; (3) North America = Canada, United States (including Alaska), and Mexico (Greenland not included); and (4) Canada				% of North American range estimated to occur in Canada (E. Dunn, unpubl. data)	**Current maximum count totals observed in each flyway** — these *do not* represent the *estimated total* numbers of birds using the flyway but the *currently observed maximum count totals* from the flyway, at whichever season they have been recorded; in other words, it is not a flyway population estimate, but an indication of the maximum observable number in the flyway			Based on Morrison et al. (1994a); B = breeds	Based on Morrison et al. (1994a); Acc = accidental; Cas = casual; Com = common; End = endangered; Rar = rare; Reg = regular; Sca = scarce; Thr = threatened; Unc = uncommon; Vul = vulnerable

[a] Shading indicates that the species is "at risk" (i.e., endangered, threatened, vulnerable).
[b] American Ornithologists' Union.

Black-bellied Plover *Pluvialis squatarola*

Code	Population estimates: Global	Neotropical	North America	Canada	% North American range in Canada	Current maximum count totals: Pacific Flyway	Interior Flyway	Eastern Flyway	Breeding status (Canada)	Abundance status (Canada)
BBPL	498 000		200 000	200 000		52 100	33 100	75 200	B	Com

Rose and Scott (1997) listed five populations globally, with estimates totalling 348 000 birds. Two populations occur in North America: *P. s. squatarola*, breeding in Alaska and wintering along the Pacific Flyway, and *P. s. cynosurae*, breeding in northern Canada and wintering on the Atlantic and Gulf coasts and areas south (Paulson 1995; Engelmoer and Roselaar 1998). The global estimate should be revised to 348 000 minus 50 000 (previous North American estimate) plus 200 000 (current North American estimate; see below) = 498 000.

The previous North American estimate of 50 000 (Morrison et al. 1994a), used by Rose and Scott (1997), would appear to be too low, based on estimates of numbers of the two subspecies from the breeding grounds, wintering areas, and migration areas. Estimates of breeding populations from six areas of the Canadian Arctic covering some 123 940 km^2 produced a total of almost 140 000 (139 555) birds (Morrison 1997), indicating that the overall population (involving only *P. s. cynosurae*) is likely to exceed 150 000. Counts from fall migration areas are as follows: eastern USA 61 400 (ISS), eastern Canada 13 800 (MSS), Interior Flyway 12 000 (Skagen et al. 1999), and Pacific Flyway 18 000 (Page et al. 1992), totalling 105 200. Spring numbers include eastern USA 26 900 (ISS), Interior Flyway 33 100 (Skagen et al. 1999), and Pacific USA 12 000 (ISS), totalling 72 000.

Winter counts from various areas include British Columbia 1440 (Butler 1992), Pacific coast USA and Baja California 45 000 (G.W. Page, unpubl. data), central USA 5000 (Harrington and Page 1992), eastern USA/Canada 3700 (Harrington and Page 1992), Mexico (excluding Baja California) 4600 (Morrison et al. 1992, 1993, 1994c), Panama 400 (Morrison et al. 1998), and South America 27 300 (Morrison and Ross 1989), totalling 87 440. Winter counts of birds on the Pacific side only of the Americas (contained in the counts just listed) include British Columbia 1440, Pacific coast USA and Baja California 45 000, remainder of Pacific coast of Mexico outside of Baja California 2741, and Pacific coast South America 2873, totalling 52 054; this suggests that the population of *P. s. squatarola* is around 50 000. The Canadian/North American wintering population recorded on Christmas Bird Counts in 1992 was 32 300 (Paulson 1995). In summary, current population estimates are 150 000 for *P. s. cynosurae* and 50 000 for *P. s. squatarola*.

American Golden-Plover *Pluvialis dominicus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
AGPL	150 000+	150 000+	150 000+	150 000+	78.2	77 900	31 200	15 000	B	Com

The initial estimate of <50 000 (Morrison et al. 1994a) would appear to be too low, based on information from breeding and migration areas. Numbers estimated in six areas of the Canadian Arctic covering some 96 060 km^2 totalled nearly 65 000 birds (Morrison 1997), whereas a further 68 900 were estimated to breed in the area of the Northeast Alaska Lagoons (Gill et al. 1999). Estimated numbers from the breeding grounds thus currently total 133 900, suggesting that the entire population would likely exceed 150 000. At migration areas, the largest numbers have been recorded during fall migration: eastern USA 2800 (ISS), eastern Canada 1700 (MSS), Interior Flyway 14 800 (Skagen et al. 1999), Pacific USA 100 (ISS), and Alaska 77 800 (Gill et al. 1999), totalling 97 200. Spring counts include eastern North America 15 000 (Harrington and Page 1992), Interior Flyway 31 200 (Skagen et al. 1999), and Pacific USA 14 (ISS), for a total of 46 210. Large numbers pass through Iowa and eastern Nebraska in spring (S. Dinsmore, pers. commun.). Counts from wintering areas in South America are lower and include 4055 from coastal areas (Morrison and Ross 1989) and 2100 from other wetlands (Scott and Carbonell 1986), totalling 6155; up to 5000 have been observed at the Lagoa do Peixe in southern Brazil on ground surveys (R.I.G. Morrison, unpubl. data). Many shorebird surveys do not cover upland areas used by the species very well, so it is difficult to assess the significance of migration and wintering count totals.

Pacific Golden-Plover *Pluvialis fulva*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
PGPL	125 000		16 000							Rar

The population of the Pacific Golden-Plover, which is thought to be rare in Canada, has been reported to be at least 90 000 (Watkins 1993; Johnson and Connors 1996). Recent revisions include an estimate of 100 000 for the nonbreeding population occurring in eastern and southeastern Asia and Australia and 25 000 for the population wintering in southwestern and southern Asia and eastern Africa (D. Watkins, pers. commun.), indicating that the global population for the species is at least 125 000. Fall counts from three sites in Alaska total 15 900 (Gill et al. 1999). The Alaskan breeding

grounds are situated along the coastline of the Bering Sea in western Alaska and occupy a fairly small proportion of the entire species' range, which extends eastwards along much of the northern coast of Russia (Hayman et al. 1986; AOU 1998); the North American population estimate is therefore tentatively given as 16 000, based on the counts from Alaska.

Snowy Plover *Charadrius alexandrinus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SNPL	**586 000**	**<10 000**	**16 000**			**410**	**7050**	**560**		**Rar/Thr**

The Snowy Plover is numerous on a global scale, with populations for which there are estimates (six of eight listed by Rose and Scott [1997]) totalling 572 000 (assuming value for listed population range of C/D as 200 000); to this total may be added the present estimate for the North American/Caribbean population of 16 000, for a global total of 586 000. Two subspecies are found in North America: *C. a. nivosus*, which is considered threatened in the United States and which occupies most of the U.S. breeding range, and *C. a. tenuirostris*, which breeds on the Gulf coast east of Louisiana and in Mexico (Page et al. 1995).

Maximum counts at sites in the United States total about 7500 during both spring and fall. Fall numbers include eastern USA 560 (ISS), Interior Flyway 6350 (Skagen et al. 1999), and Pacific USA 410 (ISS), totalling 7320. Spring counts include eastern USA 200 (ISS), Interior Flyway 7050 (Skagen et al. 1999), and Pacific USA 370 (ISS), totalling 7620. Page and Gill (1994) quoted a total population of 18 500, which was revised upwards to 21 000 by Page et al. (1995); subsequent reevaluation of the estimated number at Great Salt Lake (from 10 000 to 5000; G.W. Page, unpubl. data) produces the current figure of 16 000. This would appear consistent with a suggested range of 10 000–20 000 (S. Dinsmore, pers. commun.) based on a combination of the migration count totals above and observations that large numbers breed in the Gulf of California/Colorado River delta, as well as at various inland sites in the western United States. Estimates for the various subspecies and subpopulations are as follows: *C. a. nivosus* breeding along the Pacific coast from Washington to Baja California, wintering on the Pacific coast from California to Baja California — 2000; *C. a. nivosus* breeding at all other interior sites and on the Atlantic coast, wintering in the southern United States, Mexico, and the Caribbean — 13 235; *C. a. tenuirostris*, breeding on the Gulf coast east of Louisiana and in Mexico, wintering in the Caribbean, Cuba, and Bahamas — 500 (total 15 735).

The Canadian population is listed as blank (= zero) on the basis that its current status is rare, occurring in Canada only on a casual basis (Godfrey 1986).

The Neotropical population of this species occurring in Peru/Chile, *C. a. occidentalis*, is listed as <10 000 (R. Schlatter, pers. commun., cited in Rose and Scott 1997).

Wilson's Plover *Charadrius wilsonia*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WIPL	6000+	?	6000		0	4	5000	1770		Cas

grounds are situated along the coastline of the Bering Sea in western Alaska and occupy a fairly small proportion of the entire species' range, which extends eastwards along much of the northern coast of Russia (Hayman et al. 1986; AOU 1998); the North American population estimate is therefore tentatively given as 16 000, based on the counts from Alaska.

Snowy Plover *Charadrius alexandrinus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SNPL	**586 000**	**<10 000**	**16 000**			**410**	**7050**	**560**		**Rar/Thr**

The Snowy Plover is numerous on a global scale, with populations for which there are estimates (six of eight listed by Rose and Scott [1997]) totalling 572 000 (assuming value for listed population range of C/D as 200 000); to this total may be added the present estimate for the North American/ Caribbean population of 16 000, for a global total of 586 000. Two subspecies are found in North America: *C. a. nivosus*, which is considered threatened in the United States and which occupies most of the U.S. breeding range, and *C. a. tenuirostris*, which breeds on the Gulf coast east of Louisiana and in Mexico (Page et al. 1995).

Maximum counts at sites in the United States total about 7500 during both spring and fall. Fall numbers include eastern USA 560 (ISS), Interior Flyway 6350 (Skagen et al. 1999), and Pacific USA 410 (ISS), totalling 7320. Spring counts include eastern USA 200 (ISS), Interior Flyway 7050 (Skagen et al. 1999), and Pacific USA 370 (ISS), totalling 7620. Page and Gill (1994) quoted a total population of 18 500, which was revised upwards to 21 000 by Page et al. (1995); subsequent reevaluation of the estimated number at Great Salt Lake (from 10 000 to 5000; G.W. Page, unpubl. data) produces the current figure of 16 000. This would appear consistent with a suggested range of 10 000–20 000 (S. Dinsmore, pers. commun.) based on a combination of the migration count totals above and observations that large numbers breed in the Gulf of California/Colorado River delta, as well as at various inland sites in the western United States. Estimates for the various subspecies and subpopulations are as follows: *C. a. nivosus* breeding along the Pacific coast from Washington to Baja California, wintering on the Pacific coast from California to Baja California — 2000; *C. a. nivosus* breeding at all other interior sites and on the Atlantic coast, wintering in the southern United States, Mexico, and the Caribbean — 13 235; *C. a. tenuirostris*, breeding on the Gulf coast east of Louisiana and in Mexico, wintering in the Caribbean, Cuba, and Bahamas — 500 (total 15 735).

The Canadian population is listed as blank (= zero) on the basis that its current status is rare, occurring in Canada only on a casual basis (Godfrey 1986).

The Neotropical population of this species occurring in Peru/Chile, *C. a. occidentalis*, is listed as <10 000 (R. Schlatter, pers. commun., cited in Rose and Scott 1997).

Wilson's Plover *Charadrius wilsonia*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WIPL	6000+	?	6000		0	4	5000	1770		Cas

Rose and Scott (1997) listed four populations of Wilson's Plover globally, two of which occur in North America (*C. w. wilsonia* in the eastern United States and Gulf of Mexico and *C. w. beldingi* in Mexico, Central America, and northwestern South America); no population estimates were provided. The species is of only casual occurrence in Canada (Godfrey 1986; Morrison et al. 1994a).

The North American population would appear to be around 6000, based on counts at migration and wintering areas. The largest counts during migration occur during the spring: eastern USA 821 (ISS), Interior Flyway 5000 (in Texas; Harrington and Page 1992), and Pacific USA 1 (ISS), totalling 5822. Fall counts include eastern USA 1770 (ISS), Interior Flyway 1051 (Skagen et al. 1999), and Pacific USA 4 (ISS), totalling 2825. Winter counts in Texas (5000) and Florida (175) total 5175 (Harrington and Page 1992). Less information is available for areas farther south, and counts tend to be lower: Page et al. (1997) reported counts totalling 170 in Baja California (an earlier estimate involving extrapolation of aerial counts indicated up to 800 in this region; Page and Palacios 1993), Engilis et al. (1998) found 55 in Ensenada Pabellones and Bahia Santa Maria, Sinaloa, in Pacific northwest Mexico (extrapolated total estimated as 91), and only one (in Colombia) was specifically mentioned in wetlands listed in Scott and Carbonell (1986) in Central and South America. These numbers suggest a tentative total of approximately 6000 (range 5000–6000).

Common Ringed Plover *Charadrius hiaticula*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
CRPL	442 500		<10 000?	<10 000?	100				B	Reg

The global population of this species is large, with estimated numbers in the three wintering populations listed by Rose and Scott (1997) totalling 442 500. Part of the population wintering in western/southern Africa (estimate of 195 000: Smit and Piersma 1989; Rose and Scott 1997; estimate of 200 000: Meltofte 1985) breeds in the eastern Canadian Arctic (eastern Baffin Island and around the coast of eastern and northern Ellesmere Island; Godfrey 1986). While occurring regularly in Canada in the Arctic, it would not normally be seen in southern Canada, and the "North American" population is therefore restricted to Canada. Meltofte (1985) estimated that approximately 500 pairs (i.e., 1000 birds) nested on Ellesmere Island/eastern Axel Heiberg Island, and the Canadian population is therefore estimated to be in the thousands (<10 000).

Semipalmated Plover *Charadrius semipalmatus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SEPL	150 000		150 000	150 000	70.5	13 000	12 900	108 900	B	Com

The previous population estimate of 50 000 suggested by Morrison et al. (1994a) would appear to be too low, based on numbers seen during migration. The largest numbers have been recorded during fall migration in North America, with the following regional totals: eastern USA 61 500 (ISS), eastern Canada 47 400 (MSS), Interior Flyway 12 200 (Skagen et al. 1999), and Pacific USA 3300 (ISS), totalling 124 400; this suggests a population nearer 150 000. Spring numbers are generally lower: eastern USA 25 900 (ISS), Interior Flyway 12 900 (Skagen et al. 1999), and western North America 13 000 (G.W. Page, unpubl. data), totalling 51 800.

Fewer estimates are available from wintering or migration areas south of North America, especially where aerial surveys have been used (e.g., Mexico: Morrison et al. 1992, 1993, 1994c; Panama: Morrison et al. 1998; South America: Morrison and Ross 1989), as the species is difficult to distinguish where large flocks of small sandpipers (peeps) may be present. Watts et al. (1998) estimated that 30 600 were present in the Bay of Panama during southward migration, and totals at 17 sites in South America at which the species was mentioned in Scott and Carbonell (1986) came to 18 000.

Piping Plover *Charadrius melodus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
PIPL	5913		5913	2110			3284 total northern Great Plains (1687 Canadian Prairies, 1597 U.S. Great Plains)	2629 total: 2581 total Atlantic coast (422 Canada, 6 France, 2153 USA); 48 total Great Lakes (47 USA, 1 Canada)	B	End

The following account is based on information and references in Goosen et al. (1997) and Plissner and Haig (2000). Breeding occurs in three major areas: the northern Great Plains, Great Lakes, and Atlantic coast. The most recent census conducted in 1996 recorded 5913 birds, of which 2110 (36%) were found in Canada (422 of 2581 [16%] of the Atlantic population and 1687 of 3284 [51%] of the northern Great Plains population). Overall numbers were similar to those found in an earlier (1991) census (total 5487), although the Canadian Atlantic population had decreased somewhat (from 509 to 422 birds) and the Canadian Prairies population had increased somewhat (from 1437 to 1687 birds). The opposite pattern was observed in the United States, with an increase on the Atlantic coast (from 1466 to 2153 birds) and a decrease on the Great Plains (from 2032 to 1597 birds). The Canadian segment of the Great Lakes population (1 in Canada, 47 in the United States in 1996) appeared to have been extirpated, with no confirmed breeding between 1977 and 1997; however, two nests, which produced six young, were found in the Lake of the Woods area in Ontario in 1998 (Heyens and Anderson 1998). Haig (1992) summarized the results of earlier censuses of breeding pairs for the years 1987–1991; numbers ranged from 1843 pairs (in 1990) to 2334 pairs (in 1991).

The overall population estimate derived from these specialized, dedicated census operations agrees fairly well with information from other shorebird surveys. While seasonal totals during spring — eastern USA 928 (ISS) and Interior Flyway 2931 (Skagen et al. 1999), totalling 3859 — and fall — eastern USA 2048 (ISS), eastern Canada 570 (MSS) (although these are likely to migrate to east coast USA wintering sites, and it is not known whether such birds might be counted in both areas), and Interior Flyway 1681 (Skagen et al. 1999), totalling 4299 (including MSS counts) — are somewhat lower than the dedicated census totals above, the sum of the maximum count observed in each region (eastern USA/Canada 2618, central 2931, total 5549) approached (94%) that from the dedicated surveys (5913 in 1996).

Killdeer *Charadrius vociferus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
KILL	1 000 000+	?	1 000 000	366 000	36.6	20 000+	39 400	20 100	B	Com

The preliminary estimate of 100 000 suggested by Morrison (1993) appears to be much too low. The species is common and very widespread, with a breeding range extending from south-central/ southeastern Alaska through Canada (south of the boreal zone) and the United States to central Mexico, with some breeding in Ecuador and northern Chile (Hayman et al. 1986; AOU 1998). There is a large discrepancy between the numbers observable during migration and on wintering areas and estimates based on extrapolation of breeding densities. During migration periods, the largest numbers have been recorded during the fall: eastern USA 19 400 (ISS), eastern Canada 700 (MSS), Interior Flyway 39 400 (Skagen et al. 1999), and Pacific USA 4400 (ISS), totalling 63 900. Spring totals are generally smaller: eastern USA 3800 (ISS), Interior Flyway 18 900 (Skagen et al. 1999), and Pacific USA 1200 (ISS), totalling 23 900. G.W. Page (unpubl. data) estimates that 20 000+ winter on the Pacific coast of the United States and in Baja California. In contrast, estimates from breeding areas are much higher. In North Dakota alone, breeding populations were estimated as 227 000 (range 176 000–277 000) breeding pairs (i.e., 454 000 birds) in 1967 (Stewart and Kantrud 1972), 248 000 (range 178 000–318 000) pairs in 1992, and 312 000 (range 226 000–397 000) pairs in 1993 (Igl and Johnson 1997). Given the broad range of the species, these figures, if accurate, would imply a total population of many millions. Using BBS data to extrapolate population totals based on political divisions (mean relative abundance [density] on BBS routes within state/province, the area of the state/province, adjusting by an estimated proportion of the state/province in which the species breeds) leads to an estimate of 10.3 million birds (R.I.G. Morrison, unpubl. data). A more realistic method for approaching estimates using BBS data involves extrapolations from landscape/habitat-based (i.e., physiographic strata-based) estimates of relative abundance (density) on BBS routes and of the areas of the physiographic strata, from which a total of 2.017 million birds may be derived (using Partners in Flight physiographic strata) (R.I.G. Morrison, unpubl. data). While Killdeers are obvious, noisy birds that would be easily detected on BBS surveys, their close association with roadside habitats and the question of whether this association is likely to represent the overall density within the stratum suggest that they may well be overestimated using BBS methods. Given that BBS results indicate widespread declines in Killdeer populations in the United States and Canada (S.M. Haig, P. Sanzenbacher, and R.I.G. Morrison, unpubl. data), we would suggest adopting an intermediate value of 1 000 000 for the estimate, with a range of 200 000–2 000 000.

The size of the Neotropical population breeding in South America is unknown.

The Canadian population estimate of 366 000 has been derived from the estimated proportion of North American breeding range occurring in Canada (36.6%).

Mountain Plover *Charadrius montanus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
MOUP	9000		9000	10		6700	2500		B	End

The estimate of 5600 quoted by Morrison et al. (1994a) and Rose and Scott (1994, 1997) has since been adjusted upwards. Knopf (1996) provided a revised estimate for the North American

Fewer estimates are available from wintering or migration areas south of North America, especially where aerial surveys have been used (e.g., Mexico: Morrison et al. 1992, 1993, 1994c; Panama: Morrison et al. 1998; South America: Morrison and Ross 1989), as the species is difficult to distinguish where large flocks of small sandpipers (peeps) may be present. Watts et al. (1998) estimated that 30 600 were present in the Bay of Panama during southward migration, and totals at 17 sites in South America at which the species was mentioned in Scott and Carbonell (1986) came to 18 000.

Piping Plover *Charadrius melodus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
PIPL	5913		5913	2110			3284 total northern Great Plains (1687 Canadian Prairies, 1597 U.S. Great Plains)	2629 total: 2581 total Atlantic coast (422 Canada, 6 France, 2153 USA); 48 total Great Lakes (47 USA, 1 Canada)	B	End

The following account is based on information and references in Goosen et al. (1997) and Plissner and Haig (2000). Breeding occurs in three major areas: the northern Great Plains, Great Lakes, and Atlantic coast. The most recent census conducted in 1996 recorded 5913 birds, of which 2110 (36%) were found in Canada (422 of 2581 [16%] of the Atlantic population and 1687 of 3284 [51%] of the northern Great Plains population). Overall numbers were similar to those found in an earlier (1991) census (total 5487), although the Canadian Atlantic population had decreased somewhat (from 509 to 422 birds) and the Canadian Prairies population had increased somewhat (from 1437 to 1687 birds). The opposite pattern was observed in the United States, with an increase on the Atlantic coast (from 1466 to 2153 birds) and a decrease on the Great Plains (from 2032 to 1597 birds). The Canadian segment of the Great Lakes population (1 in Canada, 47 in the United States in 1996) appeared to have been extirpated, with no confirmed breeding between 1977 and 1997; however, two nests, which produced six young, were found in the Lake of the Woods area in Ontario in 1998 (Heyens and Anderson 1998). Haig (1992) summarized the results of earlier censuses of breeding pairs for the years 1987–1991; numbers ranged from 1843 pairs (in 1990) to 2334 pairs (in 1991).

The overall population estimate derived from these specialized, dedicated census operations agrees fairly well with information from other shorebird surveys. While seasonal totals during spring — eastern USA 928 (ISS) and Interior Flyway 2931 (Skagen et al. 1999), totalling 3859 — and fall — eastern USA 2048 (ISS), eastern Canada 570 (MSS) (although these are likely to migrate to east coast USA wintering sites, and it is not known whether such birds might be counted in both areas), and Interior Flyway 1681 (Skagen et al. 1999), totalling 4299 (including MSS counts) — are somewhat lower than the dedicated census totals above, the sum of the maximum count observed in each region (eastern USA/Canada 2618, central 2931, total 5549) approached (94%) that from the dedicated surveys (5913 in 1996).

Killdeer *Charadrius vociferus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
KILL	1 000 000+	?	1 000 000	366 000	36.6	20 000+	39 400	20 100	B	Com

The preliminary estimate of 100 000 suggested by Morrison (1993) appears to be much too low. The species is common and very widespread, with a breeding range extending from south-central/ southeastern Alaska through Canada (south of the boreal zone) and the United States to central Mexico, with some breeding in Ecuador and northern Chile (Hayman et al. 1986; AOU 1998). There is a large discrepancy between the numbers observable during migration and on wintering areas and estimates based on extrapolation of breeding densities. During migration periods, the largest numbers have been recorded during the fall: eastern USA 19 400 (ISS), eastern Canada 700 (MSS), Interior Flyway 39 400 (Skagen et al. 1999), and Pacific USA 4400 (ISS), totalling 63 900. Spring totals are generally smaller: eastern USA 3800 (ISS), Interior Flyway 18 900 (Skagen et al. 1999), and Pacific USA 1200 (ISS), totalling 23 900. G.W. Page (unpubl. data) estimates that 20 000+ winter on the Pacific coast of the United States and in Baja California. In contrast, estimates from breeding areas are much higher. In North Dakota alone, breeding populations were estimated as 227 000 (range 176 000–277 000) breeding pairs (i.e., 454 000 birds) in 1967 (Stewart and Kantrud 1972), 248 000 (range 178 000–318 000) pairs in 1992, and 312 000 (range 226 000–397 000) pairs in 1993 (Igl and Johnson 1997). Given the broad range of the species, these figures, if accurate, would imply a total population of many millions. Using BBS data to extrapolate population totals based on political divisions (mean relative abundance [density] on BBS routes within state/province, the area of the state/province, adjusting by an estimated proportion of the state/province in which the species breeds) leads to an estimate of 10.3 million birds (R.I.G. Morrison, unpubl. data). A more realistic method for approaching estimates using BBS data involves extrapolations from landscape/habitat-based (i.e., physiographic strata-based) estimates of relative abundance (density) on BBS routes and of the areas of the physiographic strata, from which a total of 2.017 million birds may be derived (using Partners in Flight physiographic strata) (R.I.G. Morrison, unpubl. data). While Killdeers are obvious, noisy birds that would be easily detected on BBS surveys, their close association with roadside habitats and the question of whether this association is likely to represent the overall density within the stratum suggest that they may well be overestimated using BBS methods. Given that BBS results indicate widespread declines in Killdeer populations in the United States and Canada (S.M. Haig, P. Sanzenbacher, and R.I.G. Morrison, unpubl. data), we would suggest adopting an intermediate value of 1 000 000 for the estimate, with a range of 200 000–2 000 000.

The size of the Neotropical population breeding in South America is unknown.

The Canadian population estimate of 366 000 has been derived from the estimated proportion of North American breeding range occurring in Canada (36.6%).

Mountain Plover *Charadrius montanus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
MOUP	9000		9000	10		6700	2500		B	Rel

The estimate of 5600 quoted by Morrison et al. (1994a) and Rose and Scott (1994, 1997) has since been adjusted upwards. Knopf (1996) provided a revised estimate for the North American

population in 1995 of 8000–10 000 birds; this was based on the number of birds found during a winter count in California in 1994 (3346, which was then doubled) plus estimated wintering populations in Texas and Mexico (1000–3000). S. Dinsmore (pers. commun.) suggested that this estimate may be somewhat low and could be increased to 10 000–15 000 birds (i.e., in the upper part of the range 5000–15 000 given by Page and Gill [1994]); we suggest retaining the "most recent" estimate of some 9000 birds (S. Jones, pers. commun.). The species is generally not recorded on ISS surveys. Maximum spring and fall counts from interior U.S. areas were 1334 and 2497, respectively (Skagen et al. 1999).

The species' range only just extends into Canada, where it is considered a rare breeder in the southern Prairie provinces (Godfrey 1986); the latest population estimate for Canada is about 4–6 pairs or generally less than 12 birds (value of 10 birds in table; RENEW 1998, 1999).

American Oystercatcher *Haematopus palliatus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
AMOY	58 850+	50 000	8850	4	0	350	140	3270		Cas

The taxonomy of oystercatchers worldwide continues to be debated, with proposals for between four and 11 species (Nol and Humphrey 1994). There are thought to be up to five subspecies of *H. palliatus* in the Western Hemisphere (Rose and Scott 1997), with two, *H. p. palliatus* and *H. p. frazari*, occurring in North America (Nol and Humphrey 1994). The nominate race *H. p. palliatus* breeds on the Atlantic and Gulf coasts of North America and in parts of the Caribbean, ranging down the Atlantic side of South America to Uruguay (Hayman et al. 1986). *H. p. frazari* breeds principally in the Pacific northwest of Mexico around the coasts of Baja California and appears to interbreed with the Black Oystercatcher *H. bachmani* (Jehl 1985); no more than a handful of birds is thought to breed in the United States on the Pacific coast (N. Warnock, pers. commun.). The group with the largest current population estimate is *H. p. pitanay*, which occurs in the western Neotropics from Panama south to Chiloe Island, Chile (population size range listed as C [= 25 000–100 000] in Rose and Scott [1997], given as 50 000 in the species account table above). Other subspecies include *H. p. durnfordi*, found on the coasts of Argentina, and *H. p. galapagensis*, found on the Galapagos Islands. A very incomplete estimate of the global population (involving estimates or partial estimates for three of the five races; see below) is therefore 58 850+.

North American populations of the species appear to be fairly small, with recent winter counts suggesting that the Central and North American population of *H. p. palliatus* numbers about 8500 (see below) (Nol et al. 2000; E. Nol, pers. commun.). Breeding populations on the Atlantic coast of the United States have been estimated to number some 3250 individuals (Nol and Humphrey 1994), although winter counts and data from Christmas Bird Counts in 1999 suggest that the population is nearer double this figure (7434 individuals or larger; Nol et al. 2000; E. Nol, pers. commun.). Counts recorded during fall migration in the United States include eastern USA 3271 (ISS), Interior Flyway 88 (ISS), and Pacific Flyway 0 (ISS) (total 3359) and are higher than those from spring (695, 142, and 1 for the respective U.S. regions [ISS], totalling 838). Christmas counts in the United States varied between about 1100 and 9100 in the early 1970s but have tended to stabilize around 2000 (1134–3558) since 1975 (Nol and Humphrey 1994). Winter counts at sites east of the 105th meridian totalled 3020 (Harrington and Page 1992) in the United States (involving *H. p. palliatus*). In Mexico, counts on the Pacific coast reported by Morrison et al. (1992, 1993, 1994b) (*H. p. frazari*) totalled 209, with those on the Gulf coast totalling 102 (*H. p. palliatus*). Page et al. (1997) reported a total of 103 occurring at two main sites in Baja California, including Laguna San Ignacio, where about 100 were previously reported in a single flock in winter (W.T. Everett, pers. commun., cited in Jehl 1985).

Winter counts from aerial surveys in Panama in January 1993 (presumably involving *H. p. pitanay*) totalled 153, all of which occurred on the Pacific coast (Morrison et al. 1998). Surveys of the Gulf of Panama in February 1988, October 1991, and January 1993 yielded counts of 67, 247, and 124, respectively (Morrison et al. 1998), and a survey of a 100-km sector of the coast in the fall of 1997 yielded 346 birds (B. Watts, pers. commun., cited in Nol et al. 2000).

The combined 1999 winter survey and Christmas Bird Count data from the east and Gulf coasts of the United States produce a total of 7434 birds, suggesting that the total for the *H. p. palliatus* population could range as high as 8500 when allowance is made for areas that were poorly covered and for islands in the Caribbean (Nol et al. 2000; E. Nol, pers. commun.). For *H. p. frazari*, combining counts for the Pacific coast of Mexico from Page et al. (1997) and Morrison et al. (1992, 1994c) (on the basis that counts did not overlap) gives a total of 103 + 209 = 312, which, if adjusted for the larger count previously noted at Laguna San Ignacio, becomes approximately 350. Highest counts on the Pacific coast of Panama (see above) come to some 350 birds, although it is not clear whether these may refer to *H. p. pitanay*.

The American Oystercatcher is generally considered of casual occurrence in Canada (Godfrey 1986; Morrison et al. 1994a), and there were no confirmed breeding records until recent years, when about two pairs have bred at Cape Sable in southern Nova Scotia (P. Hicklin and R.D. Elliot, pers. commun.).

Black Oystercatcher *Haematopus bachmani*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BLOY	8900		8900	8000		11 000			B	Reg

The estimate for the breeding population of 7600 provided by Page and Gill (1994) may be increased somewhat to 8900, representing the approximate midpoint of the range of 6900–10 800 given by Andres and Falxa (1995) (similar to the "guesstimate" of 10 000 provided by Morrison et al. [1994a]). The Canadian population is presumably smaller than the overall North American population, as the species' breeding range extends south to Baja California (Hayman et al. 1986), and has been tentatively listed as 8000.

Black-necked Stilt *Himantopus mexicanus mexicanus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BNST	850 000+	200 000+	150 000	400		16 000	120 000	5400	B	Sca

Global population estimates for this species involve a minimum of 850 000 birds, based on data for six of 10 populations (involving five races; Hayman et al. 1986) for which information is available (Rose and Scott 1997), plus the current estimate for the "North American" population, *H. m. mexicanus*. The largest numbers in North America have been recorded during fall migration: eastern USA 5400 (ISS), Interior Flyway 120 000 (Skagen et al. 1999), and Pacific USA 16 000 (Harrington and Perry 1995), totalling 141 400. Spring numbers are also substantial: eastern USA 2300 (ISS), Interior Flyway 111 600 (Skagen et al. 1999), and Pacific USA 5900 (ISS), totalling 119 800. Page and Gill (1994) reported a winter total of 25 000 for the Pacific Flyway. Winter counts include about

5700 in eastern and central USA (Harrington and Page 1992), 5600 on the Pacific coast of the USA (Page et al. 1999), and 48 800 in Mexico (Morrison et al. 1992, 1993, 1994c), totalling 60 100. These numbers suggest that just the North American segment of the population, whose overall range extends into northern South America, probably exceeds 150 000. This impression is supported by the estimate of the population obtained by extrapolation of relative densities observed on BBS surveys using Partners in Flight physiographic strata, which result in an estimate of slightly more than 175 000 (R.I.G. Morrison, unpubl. data). In view of the uncertainties regarding BBS extrapolations, we suggest retaining an estimate of 150 000 for the North American population.

Himantopus m. mexicanus reaches the edge of its range in the Canadian Prairies, although in recent years it appears to have been expanding its range. There are now thought to be some 100–300 pairs (400 individuals in the table) breeding regularly in southern Alberta (C.L. Gratto-Trevor, unpubl. data), up from the previous estimate of 100 birds (Morrison et al. 1994a).

The population size of the South American race, *H. m. melanurus*, whose distribution extends from Peru and northern Brazil to central Argentina and Chile, is listed as 25 000–100 000 (R. Schlatter, pers. commun., cited in Rose and Scott 1997). This population is also likely to be considerably larger, as aerial surveys conducted in the Pantanal wetlands in Brazil in October 1996 yielded a direct count of over 15 000 birds, with a possible extrapolated total for the region in the 50 000–100 000 range (Morrison et al. 1997, and unpubl. data). Totals listed for 19 sites at which the species was mentioned in Scott and Carbonell (1986) came to 9800.

Hawaiian Stilt *Himantopus mexicanus knudseni*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
HAST	1650		1650							

The population of the race of the Black-necked Stilt occurring on Hawaii (AOU 1998), *H. mexicanus knudseni* or Hawaiian Stilt, has been estimated as 1500–1800 (S. Reilly, pers. commun.).

American Avocet *Recurvirostra americana*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
AMAV	450 000		450 000	63 000	13.9	56 300	325 300	4900	B	Reg

The largest numbers in North America have been recorded during fall migration: eastern USA 4900 (ISS), western North America, including interior areas, 425 000 (G.W. Page, unpubl. data), and other interior sites in central USA 18 500 (Skagen et al. 1999), totalling 448 400; this indicates that the North American population very likely exceeds 450 000. Spring totals are lower: eastern USA 2500 (ISS), Interior Flyway 149 800 (Skagen et al. 1999), and Pacific Flyway 17 900 (Harrington and Perry 1995), totalling 170 200. At least 100 000 winter in North America west of the Rocky Mountains (Page and Gill 1994; Robinson et al. 1997), and Morrison et al. (1992, 1993, 1994c) recorded a total of 163 900 during aerial surveys of wintering areas in Mexico. Estimates of the population size from extrapolation of BBS data using Partners in Flight physiographic strata approach 293 000 (R.I.G. Morrison, unpubl. data).

5700 in eastern and central USA (Harrington and Page 1992), 5600 on the Pacific coast of the USA (Page et al. 1999), and 48 800 in Mexico (Morrison et al. 1992, 1993, 1994c), totalling 60 100. These numbers suggest that just the North American segment of the population, whose overall range extends into northern South America, probably exceeds 150 000. This impression is supported by the estimate of the population obtained by extrapolation of relative densities observed on BBS surveys using Partners in Flight physiographic strata, which result in an estimate of slightly more than 175 000 (R.I.G. Morrison, unpubl. data). In view of the uncertainties regarding BBS extrapolations, we suggest retaining an estimate of 150 000 for the North American population.

Himantopus m. mexicanus reaches the edge of its range in the Canadian Prairies, although in recent years it appears to have been expanding its range. There are now thought to be some 100–300 pairs (400 individuals in the table) breeding regularly in southern Alberta (C.L. Gratto-Trevor, unpubl. data), up from the previous estimate of 100 birds (Morrison et al. 1994a).

The population size of the South American race, *H. m. melanurus*, whose distribution extends from Peru and northern Brazil to central Argentina and Chile, is listed as 25 000–100 000 (R. Schlatter, pers. commun., cited in Rose and Scott 1997). This population is also likely to be considerably larger, as aerial surveys conducted in the Pantanal wetlands in Brazil in October 1996 yielded a direct count of over 15 000 birds, with a possible extrapolated total for the region in the 50 000–100 000 range (Morrison et al. 1997, and unpubl. data). Totals listed for 19 sites at which the species was mentioned in Scott and Carbonell (1986) came to 9800.

Hawaiian Stilt *Himantopus mexicanus knudseni*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
HAST	1650		1650							

The population of the race of the Black-necked Stilt occurring on Hawaii (AOU 1998), *H. mexicanus knudseni* or Hawaiian Stilt, has been estimated as 1500–1800 (S. Reilly, pers. commun.).

American Avocet *Recurvirostra americana*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
AMAV	450 000		450 000	63 000	13.9	56 300	325 300	4900	B	Reg

The largest numbers in North America have been recorded during fall migration: eastern USA 4900 (ISS), western North America, including interior areas, 425 000 (G.W. Page, unpubl. data), and other interior sites in central USA 18 500 (Skagen et al. 1999), totalling 448 400; this indicates that the North American population very likely exceeds 450 000. Spring totals are lower: eastern USA 2500 (ISS), Interior Flyway 149 800 (Skagen et al. 1999), and Pacific Flyway 17 900 (Harrington and Perry 1995), totalling 170 200. At least 100 000 winter in North America west of the Rocky Mountains (Page and Gill 1994; Robinson et al. 1997), and Morrison et al. (1992, 1993, 1994c) recorded a total of 163 900 during aerial surveys of wintering areas in Mexico. Estimates of the population size from extrapolation of BBS data using Partners in Flight physiographic strata approach 293 000 (R.I.G. Morrison, unpubl. data).

The Canadian total of 63 000 is based on the proportion of the breeding range (13.9%) occurring in Canada.

Greater Yellowlegs *Tringa melanoleuca*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
GRYE	100 000		100 000	100 000	87.7	2500	20 800	23 100	B	Com

The preliminary estimate of approximately 20 000 provided by Morrison et al. (1994a) (quoted as range B/C [=10 000–25 000/25 000–100 000] in Rose and Scott [1997]) would appear to be too low based on counts at migration areas in North America, counts from wintering areas, and estimates of breeding populations. The largest numbers in North America have been reported during fall migration: eastern USA 18 000 (ISS), eastern Canada 5100 (MSS), Interior Flyway 20 200 (Skagen et al. 1999), Pacific USA 1200 (Harrington and Perry 1995), and Alaska 1300 (Gill et al. 1999), totalling 45 800. Spring counts are rather smaller: eastern USA 10 100 (ISS), Interior Flyway 20 800 (Skagen et al. 1999), Pacific USA 900 (ISS), and Alaska 100 (Gill et al. 1999), totalling 31 900. Most of the North American population would be expected to occur in Canada. Winter counts quoted by Elphick and Tibbitts (1998) include south-central Louisiana 2700, California 12 300, Pacific coast of USA 800, Texas 7800, and Baja California 2200, totalling 25 800. Sites listed in Scott and Carbonell (1986) in five countries in South America totalled 57 700, so that these wintering totals combined come to 83 500. Spaans (1978) suggested that 50 000–100 000 winter along the coast of Suriname. These numbers suggest that the population would reach or exceed 100 000. This impression is supported by the estimate for the North American breeding population obtained by extrapolation of densities found on BBS surveys using Partners in Flight physiographic strata, which comes to approximately 137 000 (R.I.G. Morrison, unpubl. data). We suggest adopting the estimate of 100 000 pending further information.

Lesser Yellowlegs *Tringa flavipes*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
LEYE	500 000		500 000	500 000	81.4	3000	135 700	80 600	B	Com

The previous estimate of 100 000+ provided by Morrison et al. (1994a) should be revised upwards, based on counts at migration areas in North America and estimates from breeding grounds. Recorded numbers are highest during fall migration: eastern USA 74 800 (Harrington and Perry 1995), eastern Canada 5800 (MSS), Interior Flyway 135 700 (Skagen et al. 1999), and Pacific Flyway 3000 (G.W. Page, unpubl. data), totalling 219 300. Spring counts are lower: eastern USA 20 100 (ISS), Interior Flyway 79 400 (Skagen et al. 1999), and Pacific USA 300 (ISS), totalling 99 800. Alaska Shorebird Plan personnel estimated Lesser Yellowlegs populations in the 150 000–300 000 range (L. Tibbitts, pers. commun.). On the wintering grounds, sites listed in five countries in South America by Scott and Carbonell (1986) totalled 296 700. These totals have not been adjusted for birds identified simply as "yellowlegs" during surveys (i.e., where it has not been possible to distinguish between Lesser Yellowlegs and Greater Yellowlegs). In addition, the species is generally dispersed, although it may occur in large flocks, making it difficult to assess to what extent the total population is likely to exceed the numbers counted. The estimate of the breeding population obtained by

extrapolation of densities found on BBS surveys using Partners in Flight physiographic strata comes to some 821 000 birds; however, this method is likely to produce biased (possibly inflated) estimates, depending on the stage of the nesting cycle at which the surveys are conducted (L. Tibbitts, pers. commun.). We therefore suggest a current global population estimate of 500 000 (range 300 000–800 000).

Most of the North American population may be expected to occur in Canada, even though the breeding range extends well westwards into Alaska (Hayman et al. 1986).

Solitary Sandpiper *Tringa solitaria*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SOSA	25 000	25 000	25 000	25 000	83.9	200	5600	800	B	Reg

The preliminary estimate of 10 000 by Morrison et al. (1994a), referred to in Rose and Scott (1997), is probably considerably low. The species is generally dispersed during migration (Moskoff 1995), making it difficult to use counts for assessing population size, and it may be missed in some surveys. Regional/seasonal totals are generally low compared with those for many other species. Counts are highest in spring: eastern USA 500 (Harrington and Perry 1995) and Interior Flyway 5600 (Skagen et al. 1999), with no data from Pacific Flyway, totalling 6100. Fall totals include eastern USA 700 (Harrington and Perry 1995), eastern Canada 100 (MSS), Interior Flyway 2000 (Skagen et al. 1999), and Pacific Flyway 200 (G.W. Page, unpubl. data), totalling 3000. Totals for two sites in Suriname listed by Scott and Carbonell (1986) come to 3000. A minimum of 700 birds is considered to breed in Quebec (Gauthier and Aubrey 1996). It is difficult to come up with an estimate for the population from these minimal counts, but they would suggest a figure of perhaps 25 000. The population estimate obtained from extrapolation of BBS data using Partners in Flight physiographic strata is much higher (188 000 birds), but the survey method is unlikely to be suitable for detecting the species (Moskoff 1995; L. Oring, pers. commun.). Given the extensive breeding range, which covers mainly boreal habitats stretching from Alaska to eastern Canada, and extensive wintering range, involving tropical and subtropical habitats from Mexico through South America east of the Andes to Argentina (Moskoff 1995), the estimate of 25 000 might appear low; however, in view of the species' tendency to be highly dispersed in both ranges, much uncertainty remains as to how much larger it might be. We suggest adopting a conservative estimate of 25 000, with a range of 25 000–150 000, pending further information.

Willet *Catoptrophorus semipalmatus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WILL	250 000+		250 000	25 000		106 300	52 300	15 600	B	Com

Two main races occur in the Western Hemisphere — the "eastern" Willet (*C. s. semipalmatus*), breeding in eastern North America and breeding/wintering in northern Mexico and the Caribbean, some wintering as far south as northern South America (Brazil), and the "western" Willet (*C. s. inornatus*), breeding in the interior of western North America and wintering coastally in Central America and northwestern South America (Pacific and northern coasts to Suriname) (Hayman et al. 1986).

The highest counts are recorded in North America during fall migration: eastern USA 13 700 (ISS), eastern Canada 1900 (MSS), Interior Flyway 50 000 (Harrington and Page 1992), and Pacific USA 26 400 (ISS), totalling 92 000. Spring counts include eastern USA 6800 (ISS), Interior Flyway 22 200 (Skagen et al. 1999), and Pacific USA 7400 (ISS), totalling 36 400. Counts from wintering areas exceed both spring and fall totals: eastern USA 5200 (Harrington and Perry 1995), central USA 52 300 (Harrington and Page 1992), Pacific Flyway 70 000+ (Page and Gill 1994), Mexico 29 800 (Morrison et al. 1992, 1993, 1994c), Panama 4400 (Morrison et al. 1998), and South America 83 700 (replacing the Suriname total of 15 600 in Morrison and Ross [1989] by 55 000 [Scott and Carbonell 1986] to give a revised total of 83 700), totalling 245 400+ (counts occurring on Pacific coastlines of the above areas total 106 300). The overall population of both races is therefore probably at least 250 000. Estimates of the overall breeding population obtained through extrapolation of BBS densities using BBS physiographic strata are quite similar (226 000) (but smaller [133 000] if Partners in Flight physiographic strata are used; R.I.G. Morrison, unpubl. data).

Rough estimates for the two races are suggested as follows: eastern race *C. s. semipalmatus* 90 000 (South America 83 700 plus winter eastern USA 5200 = 88 900, rounded up to 90 000); western race *C. c. inornatus* 160 000 (winter central 52 300, Pacific 70 000+, Mexico 29 800, and Panama 4400 = 156 500, rounded up to 160 000).

The Canadian population is tentatively estimated to be 10% of the overall population — i.e., approximately 25 000 — but little information is available.

Wandering Tattler *Heteroscelus incanus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WATA	10 000	5000	10 000	5000	37.0	5000			B	Com

Little count information is available for this west coast species. The Canadian population is thought to be small, with a tentative estimate of 5000 (Morrison et al. 1994a). Global and total North American populations may be larger, as some birds migrate to Pacific islands (Hayman et al. 1986). Scott and Carbonell (1986) state that the Galapagos Islands constitute a major wintering area for this species. The largest known concentration in Alaska of 397 birds was recorded on Middleton Island on 30 July 1983 (Gill et al. 1999).

Spotted Sandpiper *Actitis macularia*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SPSA	150 000		150 000	113 000	50.9	1500	6000	5000	B	Com

The Spotted Sandpiper provides another good example of a species for which it is difficult to make an estimate of the population from count data alone, and the preliminary estimate of 50 000+ given by Morrison et al. (1994a) is likely to have been too low, given the species' extensive breeding range. The species is not well covered by many surveys, owing to its dispersed distribution; it tends to migrate singly or in small groups (Oring et al. 1997) and may be overlooked in large flocks of small sandpipers, especially on aerial surveys. Counts from North American surveys reflect the small concentrations usually observed on migration: fall totals include eastern USA 3100 (ISS), eastern Canada

1000 (MSS), western North America 1500 (G.W. Page, unpubl. data), and other Interior Flyway sites 2200 (Skagen et al. 1999), totalling 7800; spring totals include eastern USA 1700 (ISS), central USA 6000 (Harrington and Page 1992), and Pacific USA 200 (ISS), totalling 7900. Numbers given for sites in Suriname by Scott and Carbonell (1986) total 24 000. Breeding bird surveys in Quebec indicate a minimum population of 5000 birds in that province (Gauthier and Aubrey 1996). A much higher estimate is obtained through extrapolation of BBS data using Partners in Flight physiographic strata (656 000; R.I.G. Morrison, unpubl. data), although it is likely that BBS methods are not suitable for this species owing to its detectability and population movements (L. Oring, pers. commun.). The likely population probably lies somewhere between the lowest and highest of the above numbers, and L. Oring (pers. commun.) recommends adopting an estimate of 150 000 with a range of 50 000–250 000.

The Canadian breeding range occupies approximately 50% of the North American range, with populations nesting both south and northwest (Alaska) of Canada; the latter birds probably occur in Canada on migration, so the Canadian population is tentatively calculated as about 75% of the North American population (i.e., 113 000).

Upland Sandpiper *Bartramia longicauda*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
UPSA	350 000	350 000	350 000	10 000?		12	4600	1000	B	Unc

This species provides another example of the difficulties that may be involved in reconciling population estimates made from numbers found on migration and wintering areas with those derived from extrapolation of numbers from breeding areas, especially for a species that has gone through large fluctuations in numbers over the past century. Up until the latter part of the 1800s, the Upland Sandpiper was considered especially numerous on the grasslands of the Great Plains and even expanded its range eastwards in North America as forests were converted to agricultural land (Bent 1929; Palmer 1967). A major population crash occurred around the turn of the century, thought to be due to the combined effects in both North and South America of excessive market hunting and changes in breeding and wintering habitat (Bent 1929; White 1983; see also Page and Gill 1994). Protection from shooting led to the population rebounding, although whether to former levels seems questionable in the light of continued agricultural development; assessments of recovery have ranged from "never has regained its former numbers" (Palmer 1967) to "largely recovered" (Richards 1988). The species appears to have continued increasing over the past 25 years (Knopf 1994), especially in the central regions of the United States and Canada (BBS Trend Map 1966–1996, in Sauer et al. 1997). Recent analyses of BBS trend data, however, indicate that although there may have been an overall statistically significant increase survey-wide during the period 1966–1998, the increase has in fact been made up of a statistically significant increase during the period 1966–1979 followed by a statistically significant *decrease* over the more recent period 1980–1998 (Sauer et al. 1997).

The Upland Sandpiper tends to be dispersed on its grassland breeding and wintering habitats and to occur in small aggregations on migration (Bent 1929; Richards 1988), so that counts from migration and wintering areas have tended to suggest small populations. North American totals are highest in the spring: eastern USA 500 (Harrington and Perry 1995), Interior Flyway 4600 (Skagen et al. 1999), and Pacific USA 1 (ISS), totalling some 5100. Fall totals include eastern USA 380 (ISS), eastern Canada 4 (MSS), Interior Flyway 3450 (Skagen et al. 1999), and Pacific USA 12 (ISS), totalling some 3850. Estimates based on information from the wintering grounds suggested a population in the range 10 000–25 000 (D. Blanco, pers. commun., cited in Rose and Scott 1997).

Estimates from the breeding grounds suggest considerably larger populations. In Illinois, numbers were thought to be around 283 000 in 1907–1909 and 177 000–208 000 in 1957–1958 (Graber and Graber 1963). Estimates for North Dakota have included 91 000–183 000 breeding pairs in 1967 (Stewart and Kantrud 1972), 166 000–307 000 pairs in 1992, and 138 000–258 000 pairs in 1993 (Igl and Johnson 1997). On the basis of the estimates up to 1967 and a consideration of the distribution of the species, Page and Gill (1994) suggested that the population likely numbered between several hundred thousand and a few million birds.

This range is consistent with various estimates that can be calculated using BBS data. One approach is to take the mean population estimated for North Dakota by Igl and Johnson (1997) and calculate populations of other states in the core of the species' range (South Dakota, Nebraska, Kansas, Oklahoma, Illinois) based on relative abundances given in the BBS data set and areas of the states concerned, which leads to an estimate of 1.732 million. This approach, however, relies entirely on the accuracy of the estimate in one state (North Dakota) and takes little account of the habitat differences across the other states. Another approach is to use densities found in different physiographic strata on BBS routes and extrapolate populations based on the areas of the different strata; this leads to an estimate of 346 000 based on Partners in Flight physiographic strata and about 386 000 based on BBS strata. Given the small numbers that can be counted during migration and wintering areas and estimates from breeding grounds suggesting anywhere from hundreds of thousands to millions of birds, we suggest adopting an interim value of 350 000.

Estimates of the likely numbers breeding in Canada are more uncertain. Gauthier and Aubrey (1996) and Y. Aubrey (pers. commun.) considered the minimum population breeding in Quebec to be some 1000 birds. Calculations based on BBS coverage in Canada are not available. An estimate of some 10 000 is tentatively suggested.

Eskimo Curlew *Numenius borealis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
ESCU	<50	<50	<50	<50					B	End

There have been few, if any, reliable sightings of this endangered species in recent years. The highest reported sighting was 23 in May 1981 in Texas (Blankinship and King 1984). The global population is likely less than 50 (Gollop et al. 1986; Morrison et al. 1994a), if the species still survives. At one time, it probably numbered in the hundreds of thousands (Gill et al. 1998). No birds were found during searches of suitable habitat on wintering grounds in Argentina and Uruguay in 1993 (Blanco et al. 1993).

Whimbrel *Numenius phaeopus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WHIM	797 000+		57 000	57 000	46.5	25 100	4400	4200	B	Com

The global population of this species is at least 797 000, based on estimates for four (of six) populations (involving four subspecies) for which information is available (Rose and Scott 1997). The North American population (which was formerly separated as a species, the Hudsonian Curlew *N.*

Estimates from the breeding grounds suggest considerably larger populations. In Illinois, numbers were thought to be around 283 000 in 1907–1909 and 177 000–208 000 in 1957–1958 (Graber and Graber 1963). Estimates for North Dakota have included 91 000–183 000 breeding pairs in 1967 (Stewart and Kantrud 1972), 166 000–307 000 pairs in 1992, and 138 000–258 000 pairs in 1993 (Igl and Johnson 1997). On the basis of the estimates up to 1967 and a consideration of the distribution of the species, Page and Gill (1994) suggested that the population likely numbered between several hundred thousand and a few million birds.

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Eskimo Curlew *Numenius borealis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
ESCU	**<50**	**<50**	**<50**	**<50**					**B**	**End**

There have been few, if any, reliable sightings of this endangered species in recent years. The highest reported sighting was 23 in May 1981 in Texas (Blankinship and King 1984). The global population is likely less than 50 (Gollop et al. 1986; Morrison et al. 1994a), if the species still survives. At one time, it probably numbered in the hundreds of thousands (Gill et al. 1998). No birds were found during searches of suitable habitat on wintering grounds in Argentina and Uruguay in 1993 (Blanco et al. 1993).

Whimbrel *Numenius phaeopus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WHIM	797 000+		57 000	57 000	46.5	25 100	4400	4200	B	Com

The global population of this species is at least 797 000, based on estimates for four (of six) populations (involving four subspecies) for which information is available (Rose and Scott 1997). The North American population (which was formerly separated as a species, the Hudsonian Curlew *N.*

hudsonicus) may be divided into two subspecies/populations, with *N. p. hudsonicus* breeding west and south of Hudson Bay and *N. p. rufiventris* breeding in Alaska and east to the Melville Hills, Nunavut (Skeel and Mallory 1996; Engelmoer and Roselaar 1998). The North American birds may be distinguished genetically from the nearest subspecies/population breeding in northeastern Siberia, *N. p. variegatus* (Zink et al. 1985), whereas the two North American races may be distinguished on their morphometrics, with *N. p. hudsonicus* generally being smaller than *N. p. rufiventris* (Engelmoer and Roselaar 1998).

Count totals are highest in North America during spring migration: eastern USA 2100 (ISS), Interior Flyway 4400 (Skagen et al. 1999), western North America 25 000 (G.W. Page, unpubl. data), and Alaska 100 (Gill et al. 1999), totalling 31 600. Fall counts include eastern USA 3100 (ISS), eastern Canada 1100 (MSS), central USA 500 (Harrington and Page 1992), Pacific USA 750 (ISS), and Alaska 3900 (Gill et al. 1999), totalling 9350. These are exceeded by counts from breeding and wintering areas. Data in Gill et al. (1999) indicate a possible total of 36 000 birds (3% of an estimated 1.2 million shorebirds) on the Yukon River delta in Alaska, which, combined with an estimated 2600 for the Mackenzie River delta (Morrison 1997), indicates a total from the breeding grounds of at least 38 600; these estimates would involve the subspecies *N. p. rufiventris*. Wintering ground counts include Mexico 1900 (Morrison et al. 1992, 1993, 1994c), Panama 1600 (Morrison et al. 1998), and South America 27 100 (replacing the 3300 for Suriname in Morrison and Ross [1989] with 5500 from Scott and Carbonell [1986] for this country), totalling 30 600.

Skeel and Mallory (1996) indicated that the migration routes used by the two subspecies are generally separate and suggested that little mixing occurs; the western population would appear to winter on the Pacific side of the Americas, whereas the eastern population occupies wintering grounds on the Atlantic and Gulf coasts of the Americas. If this is the case, a rough estimate (from counts) of the size of the *N. p. hudsonicus* population would come from numbers found on the north and east coasts of South America and around the Caribbean and Gulf coasts of the United States, Central America, and South America; available data include the north and Atlantic coasts of South America 17 457 (replacing count in Suriname as above) plus 210 (Morrison and Ross 1989), the Gulf/Caribbean coasts of Mexico 57 (Morrison et al. 1993), and the Gulf coast of Panama 88 (Morrison et al. 1998), totalling some 17 800.

Rounding the subspecies estimates to 39 000 for *N. p. rufiventris* and to 18 000 for *N. p. hudsonicus* produces a North American population estimate of 57 000, which is consistent with the current listing by Rose and Scott (1997) (range C, 25 000–100 000; see Skeel and Mallory 1996).

Bristle-thighed Curlew *Numenius tahitiensis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BTCU	10 000		10 000	0						Acc

The Bristle-thighed Curlew, which breeds in western Alaska and winters in Oceania, is thought to have a population of some 10 000 birds (R.E. Gill, pers. commun., cited in Collar et al. 1992; see also Rose and Scott 1997). This figure is derived from an estimate for the breeding population of approximately 7000 based on breeding ground surveys (Gill and Redmond 1992; Page and Gill 1994) plus an estimated oversummering population of approximately 3000 (birds 1–3 years old). The present estimate for the breeding population of 3313 pairs, with a 95% confidence interval of 2239–4387 pairs (R.E. Gill and C. Handel, pers. commun.), suggests a population range of 7500–11 800 individuals.

It is rarely seen in Canada, being considered of accidental occurrence by Godfrey (1986) and listed as casual in British Columbia by Campbell et al. (1990) on the basis of two acceptable records.

Long-billed Curlew *Numenius americana*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
LBCU	20 000		20 000	1000s		11 200+	8100	160	B	Vu

The previous estimate of 6500 (de Smet 1992 [500 Pacific, 6000 central]; see also Morrison et al. 1994a; Rose and Scott 1997) would appear to be too low, based on counts at migration areas in North America. The highest counts recorded in North America occur in the fall: eastern USA 30 (ISS), Interior Flyway 8100 (Skagen et al. 1999), and Pacific USA 6000 (Harrington and Perry 1995), totalling 14 130. Spring counts include eastern USA 10 (ISS), Interior Flyway 5030 (Skagen et al. 1999), Pacific USA 420 (ISS), totalling 5460. S. Dinsmore (pers. commun.) reports flocks numbering more than 750 birds in Montana. Winter counts include eastern and mid USA 160 and 140, respectively (Harrington and Perry 1995), western North America including Baja California 11 000+ (G.W. Page, unpubl. data), and Mexico (other than Baja California) 210 (Morrison et al. 1992, 1993, 1994c), totalling 11 510. These counts suggest a population of perhaps 20 000. Given the size of the species and its relatively obvious nature, it would seem unlikely that major parts of the population would go unrecorded on migration or wintering surveys. Estimates based on extrapolation from densities recorded on BBS surveys using Partners in Flight physiographic strata are much higher (168 000 birds; R.I.G. Morrison, unpubl. data) but are considered unrealistic; the coarse nature of the strata and unknown proportion of specific land cover types, limited number of BBS routes within some strata, and spotty distribution of the species suggest that extrapolations will be subject to large errors, probably overestimates (R. Redmond, pers. commun.). Until evidence is available to the contrary, we would recommend adopting a population estimate of 20 000 (range 15 000–20 000) birds.

The species is listed as vulnerable in Canada (COSEWIC 1998); the Canadian breeding population probably numbers several thousand birds.

Hudsonian Godwit *Limosa haemastica*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
HUGO	50 000	50 000	50 000	50 000	41.6	230	17 200	11 000	B	Reg

The Western Hemisphere (i.e., global) population is presumed to be at least 50 000, based on the South American wintering grounds survey total of 46 000 (Morrison and Ross 1989). Count totals of birds on migration in North America reach 17 000–20 000. Spring numbers include eastern USA 500 (Harrington and Perry 1995), Interior Flyway 17 200 (Skagen et al. 1999), and Pacific USA 2 (ISS), totalling some 17 700; fall numbers consist of eastern North America 10 200 (Harrington and Page 1992) (includes 10 000 in James Bay; see Morrison and Harrington 1979), eastern Canada 800 (MSS), Interior Flyway 9400 (Skagen et al. 1999), Pacific USA 0 (ISS), and Alaska 230 (Gill et al. 1999), totalling 20 630. Data in Gill et al. (1999) indicated that as many as 36 000 (3% of an estimated 1.2 million shorebirds) may occur (breeding) on the Yukon River delta in Alaska. The populations breeding in the western part of the breeding range in Alaska appear to be genetically distinct from those breeding in more central areas (Haig et al. 1997) and probably migrate to wintering areas

It is rarely seen in Canada, being considered of accidental occurrence by Godfrey (1986) and listed as casual in British Columbia by Campbell et al. (1990) on the basis of two acceptable records.

Long-billed Curlew *Numenius americana*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
LBCU	20 000		20 000	1000s		11 200+	8100	160	B	Vul

The previous estimate of 6500 (de Smet 1992 [500 Pacific, 6000 central]; see also Morrison et al. 1994a; Rose and Scott 1997) would appear to be too low, based on counts at migration areas in North America. The highest counts recorded in North America occur in the fall: eastern USA 30 (ISS), Interior Flyway 8100 (Skagen et al. 1999), and Pacific USA 6000 (Harrington and Perry 1995), totalling 14 130. Spring counts include eastern USA 10 (ISS), Interior Flyway 5030 (Skagen et al. 1999), Pacific USA 420 (ISS), totalling 5460. S. Dinsmore (pers. commun.) reports flocks numbering more than 750 birds in Montana. Winter counts include eastern and mid USA 160 and 140, respectively (Harrington and Perry 1995), western North America including Baja California 11 000+ (G.W. Page, unpubl. data), and Mexico (other than Baja California) 210 (Morrison et al. 1992, 1993, 1994c), totalling 11 510. These counts suggest a population of perhaps 20 000. Given the size of the species and its relatively obvious nature, it would seem unlikely that major parts of the population would go unrecorded on migration or wintering surveys. Estimates based on extrapolation from densities recorded on BBS surveys using Partners in Flight physiographic strata are much higher (168 000 birds; R.I.G. Morrison, unpubl. data) but are considered unrealistic; the coarse nature of the strata and unknown proportion of specific land cover types, limited number of BBS routes within some strata, and spotty distribution of the species suggest that extrapolations will be subject to large errors, probably overestimates (R. Redmond, pers. commun.). Until evidence is available to the contrary, we would recommend adopting a population estimate of 20 000 (range 15 000–20 000) birds.

The species is listed as vulnerable in Canada (COSEWIC 1998); the Canadian breeding population probably numbers several thousand birds.

Hudsonian Godwit *Limosa haemastica*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
HUGO	50 000	50 000	50 000	50 000	41.6	230	17 200	11 000	B	Reg

The Western Hemisphere (i.e., global) population is presumed to be at least 50 000, based on the South American wintering grounds survey total of 46 000 (Morrison and Ross 1989). Count totals of birds on migration in North America reach 17 000–20 000. Spring numbers include eastern USA 500 (Harrington and Perry 1995), Interior Flyway 17 200 (Skagen et al. 1999), and Pacific USA 2 (ISS), totalling some 17 700; fall numbers consist of eastern North America 10 200 (Harrington and Page 1992) (includes 10 000 in James Bay; see Morrison and Harrington 1979), eastern Canada 800 (MSS), Interior Flyway 9400 (Skagen et al. 1999), Pacific USA 0 (ISS), and Alaska 230 (Gill et al. 1999), totalling 20 630. Data in Gill et al. (1999) indicated that as many as 36 000 (3% of an estimated 1.2 million shorebirds) may occur (breeding) on the Yukon River delta in Alaska. The populations breeding in the western part of the breeding range in Alaska appear to be genetically distinct from those breeding in more central areas (Haig et al. 1997) and probably migrate to wintering areas

on the Pacific side of South America. Not enough is known about the likely accuracy of the estimated size of the breeding population in Alaska (Yukon River delta area) or about the efficiency and accuracy of the aerial surveys on the wintering grounds to determine whether the population may be larger than the current estimate of 50 000.

Bar-tailed Godwit *Limosa lapponica*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BTGO	1 345 000		100 000							

The global population of the Bar-tailed Godwit, involving some 3–5 subspecies (del Hoyo et al. 1996; Higgins and Davies 1996; Engelmoer and Roselaar 1998), is listed by Rose and Scott (1997) as 1 345 000 (range 1 200 000–2 200 000). The population breeding in Alaska, *L. l. baueri*, which stages in western and southwestern Alaska prior to migration to wintering grounds in New Zealand (Gill and McCaffery 1999), has been estimated at 100 000 birds (Gill and McCaffery 1999; Riegen 1999; Sagar et al. 1999). The population of *L. l. baueri* wintering in Australasia, which has been estimated at 330 000 birds (Watkins 1993, and pers. commun.; see also Rose and Scott 1997), is likely to include birds breeding in eastern Siberia, which Engelmoer and Roselaar (1998) argued should be assigned to a new subspecies, *L. l. anadyrensis*.

Marbled Godwit *Limosa fedoa*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
MAGO	171 500		171 500	103 000	59.6	36 000	58 700	1500	B	Reg

The preliminary estimate of 10 000? by Morrison et al. (1994a) is much too low; a figure of at least 173 500 is more realistic based on maximum counts during migration in North America, winter totals, and estimates of isolated breeding populations. Three disjunct populations are found in North America. The major part of the population breeds in the grasslands of the northern United States and southern Canada (*L. f. fedoa*), and smaller isolated populations nest in southwestern James Bay (*L. f. fedoa*) and southwestern Alaska (*L. f. beringiae*) (Gibson and Kessel 1989; Gratto-Trevor 2000).

Counts from the fall migration period include eastern USA 1500 (ISS), eastern Canada 3 (MSS), Interior Flyway 58 700 (Skagen et al. 1999), and Pacific USA 34 400 (ISS), totalling 94 600. Spring numbers include eastern USA 800 (ISS), Interior Flyway 55 300 (Skagen et al. 1999), and Pacific USA 36 000 (ISS), totalling 92 100. The relatively small numbers reported from Alaska during migration (fall 1450, spring 1910; Gill et al. 1999) are likely to be included in counts from other regions. In Panama, some 700 Marbled Godwits were reported during aerial surveys in October 1991 (Morrison et al. 1998), although the species was not noted during January (1993) and February (1988) surveys. Counts from wintering areas include eastern USA 300 (Harrington and Perry 1995), central USA 10 (Harrington and Perry 1995), western North America and Baja California 130 000 (G.W. Page, unpubl. data), and Mexico (excluding Baja California) 22 800 (Morrison et al. 1992, 1993, 1994c), totalling 153 110, indicating that the population is at least 160 000. Gratto-Trevor (2000) estimated the population range from wintering numbers as 140 000–200 000 based on the western North America (40 000) and Baja California (90 000) total of 130 000 (from G.W. Page, unpubl. data, as above) and a total of 11 000–37 000 for the remainder of Mexico derived from counts

given in Morrison et al. (1992, 1993, 1994c), Page et al. (1997), Engilis et al. (1998), and B.A. Harrington (unpubl. data). Note that this estimate of 170 000 (midpoint of 140 000–200 000 range) is likely to include both the main part of the population breeding on the interior grasslands as well as the population breeding in Alaska, which has been estimated as 1000–3000 birds (see Gratto-Trevor 2000). Estimates made from breeding ground data are fairly similar: the estimate derived from extrapolation of estimates of densities recorded on BBS surveys using Partners in Flight physiographic strata is 135 000 (R.I.G. Morrison, unpubl. data). The population breeding in James Bay has been estimated as 1000–2000 birds (R.K. Ross, pers. commun., cited in Gratto-Trevor 2000).

In summary, the overall estimate for the three populations would be as follows: *L. f. fedoa* (interior grasslands) 170 000 (140 000–200 000); *L. f. fedoa* (James Bay) 1500 (1000–2000); *L. f. beringiae* (Alaska) 2000 (1000–3000) included in 170 000 above, for a total of 171 500 (141 000–202 000).

Approximately 60% of the breeding range occurs in Canada, suggesting a Canadian population of around 103 000.

Ruddy Turnstone *Arenaria interpres*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
RUTU	449 000		235 000	235 000	73.1	9100	21 000	138 600	B	Com

Two races of Ruddy Turnstones breed in the North American Arctic. *Arenaria i. interpres* breeds in the northeastern parts of the Canadian High Arctic and migrates to wintering areas in Europe (Morrison 1975, 1976; Godfrey 1986), whereas *A. i. morinella* breeds in the central and lower parts of the Canadian Arctic (Godfrey 1986) and into eastern Alaska (Cramp and Simmons 1983) and moves to wintering areas in the Western Hemisphere. Birds breeding farther west in Alaska are usually also referred to the nominate race *A. i. interpres* but migrate to wintering areas in Pacific islands and locally from California into Mexico (Cramp and Simmons 1983).

The European wintering population (not including potentially significant numbers in Iceland, Ireland, and Norway; Snow and Perrins 1998) has been estimated as about 67 000 (Smit and Piersma 1989; Rose and Scott 1997; Snow and Perrins 1998), of which rather more than half may breed in Canada (the rest in Greenland; Meltofte 1985). This suggests a Canadian population of this subspecies of at least 35 000.

The earlier estimate of 30 000–50 000 for *A. i. morinella* (Morrison et al. 1994a) had been based on the only large-scale survey total available (23 500 for South America; Morrison and Ross 1989) and seemed likely to be low, as more recently available regional/seasonal totals for North America confirm. A high proportion of the population is thought to pass through major east coast migration sites in the spring, suggesting that a substantial proportion of the population can be counted in this region at this season. Excluding counts from the Pacific side, which are likely to refer to the nominate race, counts for *A. i. morinella* during spring migration may be considered as follows: eastern USA 138 600 (ISS) and Interior Flyway 21 000 (Skagen et al. 1999), totalling 159 600. Counts during fall migration are considerably lower: eastern USA 17 200 (ISS), eastern Canada 4600 (MSS), and Interior Flyway 2100 (Skagen et al. 1999), totalling 23 900. Counts from the wintering grounds likely to involve *A. i. morinella* are somewhat intermediate: east and central USA 100 and 500, respectively (Harrington and Perry 1995), Mexico (Gulf of Mexico/Caribbean) 500 (Morrison et al. 1993), Panama (Caribbean) 70 (Morrison et al. 1998), and South America (North and Atlantic coasts) 45 550 (replacing the 600 for Suriname in Morrison and Ross [1989] by 25 000 given for this

country by Scott and Carbonell [1986]), totalling 46 720. Extrapolated totals from five major breeding regions covering 116 170 km^2 in the Canadian Arctic came to 86 900 (Morrison 1997). On the basis of the spring total, the Arctic estimate, and the fact that the species is widespread and common, it appears possible that the North American population of *A. i. morinella* may reach 180 000.

Counts from migration and wintering areas in the Western Hemisphere likely to involve the western populations of *A. i. interpres* (here taken simply as the birds counted on the Pacific coasts of North, Central, and South America) are lower, as many of the breeding population move to islands in the Pacific Ocean. Spring counts include Pacific USA 700 (ISS); fall counts include Pacific USA 500 (ISS) and Alaska 8600 (Gill et al. 1999), totalling 9100 (note also the records of up to 10 000 turnstones on southward migration through the Pribiloff Islands; Thompson 1973); and winter counts include Pacific USA 500 (Harrington and Perry 1995), Mexico (Pacific) 410 (Morrison et al. 1992, 1994c), Panama (Pacific) 205 (Morrison et al. 1998), and South America (Pacific, although it is not clear whether these birds may be *A. i. morinella*) 2350 (Morrison and Ross 1989), totalling 3465. In Alaska, 11 200 were estimated to breed in the Northeast Alaska Lagoons area (Gill et al. 1999). On the basis of the breeding estimates and numbers recorded during fall migration, it seems likely that the Alaskan population of *A. i. interpres* may reach 20 000.

This would bring the global total for the species to 449 000, based on the ranges in Rose and Scott (1997) and an adjusted total for the North American population of *A. i. morinella*.

Black Turnstone *Arenaria melanocephala*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BLTU	80 000		80 000	80 000		80 000				Com

Handel and Gill (1992) and Page and Gill (1994) provided a population estimate of 61 000–99 000 (J. Trapp, pers. commun., cited in Rose and Scott 1997; given as 80 000 in the table) for this species. Gill et al. (1999) indicated that over 90% of the flyway population of the species (80 000) nests on the outer central Yukon-Kuskokwim Delta in Alaska. Spring and fall count data from Alaska total 29 240 and 835, respectively (Gill et al. 1999). Few other count data are available. Harrington and Perry (1995) reported totals of 300, 1200, and 600 for fall, winter, and spring Pacific counts, respectively. Most of the population is likely to pass through Canada en route to more northerly breeding grounds in Alaska; perhaps 10 000 winter on the Pacific coast of Canada (R. Butler, pers. commun.).

Surfbird *Aphriza virgata*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SURF	70 000		70 000	70 000	27.5	70 000			B	Reg

The provisional estimate of 5000–10 000 (Morrison et al. 1994a) is too low. Few counts are available. Up to 56 000 were recorded in a single day in Prince William Sound, Alaska (P. Martin, pers. commun., cited in Senner and McCaffery 1997; see also Gill et al. 1999), to which may be added 14 000 in Kachemak Bay, Alaska (Gill et al. 1999), for a spring total of some 70 000 (i.e., at the upper end of the estimate of 50 000–70 000 given by Page and Gill [1994]). Senner and McCaffery (1997)

considered the population might range as high as 100 000 (plus or minus a few tens of thousands). A figure of 70 000 is retained in the present estimates pending further information.

Red Knot *Calidris canutus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
REKN	1 291 000	167 000	400 000 (170 000 *rufa*, incl. Interior Flyway, but see text; 80 000 *islandica*; 150 000 *rogersi* + *roselaari*)	256 000 (170 000 *rufa*, incl. Interior Flyway, but see text; 80 000 *islandica*; 6000 *rogersi* + *roselaari*)	91.5	150 000 (incl. Alaska)	20 000	150 000	B	Com

Global populations of the five recognized subspecies of knots (Piersma and Davidson 1992a,b) may reach 1 291 000 (Rose and Scott 1997).

The northeastern Canadian High Arctic is occupied by *C. c. islandica*; this subspecies winters in Europe, where the wintering population in the mid-1980s was estimated as 347 000 (Smit and Piersma 1989). Initial estimates of breeding populations by Meltofte (1985) included 10 000 pairs on Ellesmere Island and eastern Axel Heiberg Island, which made up half of the estimated total population there and in Greenland; the overall total (20 000 pairs) was still very low in relation to the European wintering total. Meltofte (1985) suggested that if an additional 15 000 pairs nested on Devon Island, western Axel Heiberg Island, and other islands to the west in the Canadian Arctic, the Canadian total would be 25 000 pairs (which, with the Greenland birds, would account for half the wintering population, assuming production of two fledged juveniles per pair and 50% survival of the previous year's juveniles [which form a nonbreeding population of 1-year-old birds]). It appears likely that Meltofte's (1985) density estimates were low, and recalculation of the Canadian population size using more extensive estimates of breeding areas and probable densities by Whitfield et al. (1996) resulted in a figure of 40 870 pairs (81 740 birds). The Canadian population of *C. c. islandica* is listed on this basis as 80 000 birds.

Calidris c. rufa occupies the central Canadian Arctic and is thought to winter in southern South America (Morrison and Harrington 1992). Estimates of population levels during the past decade based on counts and banding have been in the range 100 000–150 000 (Harrington et al. 1988; Morrison and Harrington 1992). Maximum counts recorded during spring migration in North America include eastern USA 142 700 (ISS), Interior Flyway 18 700 (Skagen et al. 1999), and Pacific Flyway 6000 (G.W. Page, unpubl. data), totalling 167 400. The population wintering in southern South America is thought to pass through the eastern coast of the United States, particularly Delaware Bay, in spring; the east coast count of 142 700 is thus consistent with previous estimates of about 150 000 for this population, which makes up the bulk of *C. c. rufa*. Considerable concern has been expressed recently about the status of *C. c. rufa* (Baker et al. 1999), and it is possible that the population is significantly lower. Estimate of numbers occurring in Delaware Bay on spring migration, when most of the population is thought to use this site, are about 80 000, and this number is consistent with estimates made from resightings of banded birds in both North and South America (Baker et al. 1999). Trend analyses of ISS and MSS data up to 1991 suggested declines that were possibly substantial although not statistically significant (Howe et al. 1989; Morrison et al. 1994b). Recent aerial surveys (January 2000), however, of the main wintering locations in Tierra del Fuego (L. Niles and R.K. Ross, pers. commun.) showed little change in numbers from the 53 300 observed there in 1985 (Morrison and Ross 1989).

The subspecific status of populations passing through midcontinental North America is less certain. These knots may consist of birds wintering from Florida through the north coast of South America, and the spring sum of 19 000 for the central United States is consistent with counts of wintering birds from these areas (about 20 000; Morrison and Harrington 1992; Piersma and Davidson 1992a).

Less is known about populations wintering on and moving along the Pacific coast of North America and Mexico (and how they relate to knots found in Alaska). G.W. Page (unpubl. data) estimates that 6000 Red Knots are found on the Pacific coasts of the United States and Baja California in spring. In Alaska, a maximum count of 40 000 was recorded on the Copper River delta in May 1975, and up to 100 000 are thought to use the area (Kessel and Gibson 1978; Islieb 1979; Kessel 1989). Gill and Handel (1990) reported flocks totalling 110 000 on the central Yukon-Kuskokwim Delta in spring 1980. Maximum count totals in Alaska in spring thus reach 150 000 knots. The breeding origins and wintering destinations of these birds are not clear and their subspecific status remains uncertain, but they presumably belong to the *rogersi* or *roselaari* groups (Gill and Handel 1990; Piersma and Davidson 1992a; Gill et al. 1994). It is likely that they involve birds wintering in Australasia and other parts of the Pacific, possibly including the Pacific coast of the Americas.

Numbers occurring in different regions of North America may be summarized as follows on the basis of spring counts and breeding estimates: northeastern Canadian High Arctic 80 000 (*C. c. islandica*), eastern North America 150 000 (*C. c. rufa*; possibly fewer, see above), central North America 20 000 (?), Alaska 150 000 (*C. c. rogersi*/*C. c. roselaari*) (includes the Pacific 6000) (total 400 000).

Sanderling *Calidris alba*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SAND	643 000	112 000+	300 000	300 000	97.8	50 000	130 400	115 900	B	Com

The previous estimate for the North American population (111 800; Morrison et al. 1994a) was based on the wintering total recorded by Morrison and Ross (1989) for South America alone and is therefore likely to be too low. Counts are now available for other wintering areas and migration sites, and these suggest that a total nearer 300 000 would be more appropriate. Counts from wintering areas now include eastern USA 14 500 (Harrington and Page 1992), central USA 100 000 (Harrington and Page 1992), Pacific USA 9900 (Harrington and Perry 1995), Mexico 22 900 (Morrison et al. 1992, 1993, 1994c), Panama 1000 (Morrison et al. 1998), and South America 111 800 (Morrison and Ross 1989), for a total of 260 100. Counts at migration areas in North America are also substantial and produce totals over 200 000. Fall counts include eastern USA 99 000 (ISS), eastern Canada 16 900 (MSS), central USA 100 000 (Harrington and Page 1992), and western North America 50 000 (G.W. Page, unpubl. data), totalling 265 900. Spring counts include eastern USA 68 000 (ISS), Interior Flyway 130 400 (Skagen et al. 1999), and Pacific USA 5100 (ISS), totalling 203 500. Estimates of numbers from three areas in the Canadian Arctic covering some 96 380 km^2 totalled 136 800 (Morrison 1997).

Sanderlings breeding in the northeastern Canadian High Arctic are thought to migrate to Europe for the winter (Morrison 1992); no numerical estimates are available for this segment of the population.

The global total for the five populations listed in Rose and Scott (1997) may be adjusted from 493 000 to 643 000 on the basis of the increased Nearctic population estimate.

Semipalmated Sandpiper *Calidris pusilla*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SESA	3 500 000	3 500 000	3 500 000	3 500 000	84.9	700	260 700	994 600	B	Abu

The listed population estimate of 3.5 million is based on the midpoint of the range 2–5 million, derived from counts and banding, given by Morrison et al. (1994a). Newly available information supports this figure. Counts are largest during fall migration in North America: eastern USA 237 600 (ISS), eastern Canada 757 000 (MSS) (total 994 600 for eastern North America), Interior Flyway 98 700 (Skagen et al. 1999), Pacific USA 9 (ISS), and Alaska 27 800 (Gill et al. 1999), for an overall total of 1 121 100. Counts are lower, but still substantial, during spring migration: eastern USA 325 800 (ISS), Interior Flyway 260 700 (Skagen et al. 1999), and Pacific USA 700 (ISS), totalling 587 200.

Information from the breeding grounds is fairly limited. Estimates from six areas of the Canadian Arctic covering 88 500 km^2 totalled 122 700, with estimates from another four areas in Alaska totalling 219 800; the combined total is 342 500.

Counts from wintering areas are approximately double those found on spring migration in North America and include South America 2 142 000 (Morrison and Ross 1989), Panama 47 100 (Watts et al. 1998), and eastern USA 620 (Harrington and Perry 1995), totalling 2 189 700; little information is available from other parts of the wintering range, which includes Central America and the Caribbean (Gratto-Trevor 1992). Note that the counts given in Scott and Carbonell (1986) for various segments of the coast of Suriname total 4 500 000; the total for all sites for which counts are provided in South America was 4 792 400. Spaans (1984) reported an estimated peak number of 2–5 million in Suriname.

Western Sandpiper *Calidris mauri*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WESA	3 500 000		3 500 000	3 500 000		1 000 000	138 000	47 500		Abu

Previous estimates of 2–3 million (Morrison et al. 1994a), possibly as many as 6.5 million (Islieb 1979; Wilson 1994), may be updated to 3.5 million, based on estimates derived from numbers passing through the Copper River delta in Alaska (Bishop et al. 2000). Many of these birds are likely to occur on the Pacific coast at some point during their annual cycle; 1-day counts during spring migration along the Pacific Flyway from California to Alaska total 250 000–1 000 000 birds (Butler et al. 1996). Counts of wintering birds total over 1.5 million: eastern USA 40 700 (Harrington and Page 1992), mid USA 128 900 (Harrington and Page 1992), California wetlands 195 000 (Page et al. 1992), Mexico 828 000 (Morrison et al. 1994c), Costa Rica 600 (Smith and Stiles 1979), and Panama 328 900 (fall total used, as all birds winter in or south of Panama, and no winter totals south of Panama included; Morrison et al. 1998), totalling 1 522 100. Large numbers of Western Sandpipers are thought to occur in Nicaragua (I. Davidson, pers. commun.).

Counts are available for spring and fall migration periods in North America. Spring numbers include eastern USA 14 600 (ISS), Interior Flyway 116 900 (Skagen et al. 1999), and California wetlands 525 000 (Page et al. 1992), totalling 656 500, with 731 900 recorded during spring migration in Alaska (Gill et al. 1999). Fall counts include eastern USA 47 500 (ISS), Interior Flyway 138 000

(Skagen et al. 1999), and California wetlands 285 000 (Page et al. 1992), totalling 470 500, with 249 500 from Alaska (Gill et al. 1999). Butler et al. (1987) estimated that up to 2.4 million may pass through British Columbia on fall migration.

Least Sandpiper *Calidris minutilla*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
LESA	600 000		600 000	600 000	70.7	150 000	322 700	101 900	B	Com

Earlier estimates include 50 000–100 000 for Canada by Morrison et al. (1994a) and range C/D (25 000–100 000/100 000–1 000 000) by Rose and Scott (1997). It would now appear that the population is at least 600 000, perhaps considerably more (i.e., in the range suggested by Rose and Scott [1997]), as indicated by fall counts in North America: eastern USA 70 900 (ISS), eastern Canada 31 000 (MSS), Interior Flyway 322 700 (Harrington and Page 1992), and western USA and Baja California 150 000 (G.W. Page, unpubl. data), totalling 574 600 (a further 11 000 were reported from Alaska by Gill et al. [1999]). Spring counts are generally lower: eastern USA 37 700 (ISS), central USA 124 600 (Harrington and Page 1992), and Pacific (California wetlands) 48 000 (Page et al. 1992), totalling 210 300. Few estimates are available from wintering areas. Aerial surveys may miss the species where it occurs with flocks of other peeps or occurs in habitats away from coastlines; the species is also difficult to census from the ground owing to its similarity to other small sandpipers (Cooper 1994). Counts provided for sites in Suriname and Venezuela by Scott and Carbonell (1986) total 41 000, and Spaans (1978) estimated 50 000–100 000 in Suriname. Least Sandpipers presumably make up a significant, but unknown, proportion of the estimated 2.1 million small sandpipers on the north coast of South America (Morrison and Ross 1989; Cooper 1994).

White-rumped Sandpiper *Calidris fuscicollis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WRSA	400 000	400 000	400 000	400 000	95.7		343 300	23 300	B	Com

Previous estimates (50 000+ for Canadian population: Morrison et al. 1994a; 73 000 for South America wintering population: Morrison and Ross 1989) were based on few data and were clearly too low. New information, particularly from the Interior Flyway, has improved the number of data available considerably, and an estimate of 400 000 is suggested based on spring counts in North America and estimates from Canadian Arctic breeding areas. The species has a pronounced elliptical migration pattern (see Parmelee 1992), passing northward in large numbers through interior sites in the spring and returning south through the east coast at points north of the Bay of Fundy in the fall, where few counts are conducted. Spring counts include 6900 eastern USA (Harrington and Perry 1995) and 343 300 Interior Flyway (Skagen et al. 1999), with none reported from the Pacific coast (ISS), totalling 350 200. Fall totals are rather lower: eastern USA 3400 (ISS), Maritime provinces of Canada 9900 (MSS), Magdalen Islands 10 000 (Hagar 1956), and Interior Flyway 5200 (Skagen et al. 1999), with none reported from the Pacific coast (ISS), totalling 28 500.

The highest regional population estimate currently comes from the Arctic, where totals from five areas covering some 116 170 km^2 came to 365 700 (Morrison 1997). This estimate and the spring count total suggest the population could number 400 000, probably more.

Baird's Sandpiper *Calidris bairdii*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BASA	300 000	300 000	300 000	300 000	79.8	1500	142 900	1090	B	Com

Few count data were available when Morrison et al. (1994a) suggested an initial estimate of 50 000++ for Canada. Spring count totals in North America fall in the range 140 000–150 000 (see below), but a figure of 150 000 may be too low, on the basis of the species being one of the most abundant calidrids during spring migration on the U.S. Great Plains (almost as abundant as White-rumped Sandpiper; S. Dinsmore, pers. commun.). A tentative estimate of 300 000 is therefore suggested. Spring counts include eastern USA 550 (Harrington and Perry 1995), Interior Flyway 142 900 (Skagen et al. 1999), and Pacific USA 70 (ISS), totalling 143 520. Fall counts are lower and include eastern USA 990 (Harrington and Perry 1995), Quebec 100 (Y. Aubrey, pers. commun.), central USA 86 110 (Harrington and Page 1992), western North America 1500 (G.W. Page, unpubl. data), and Alaska 3200 (Gill et al. 1999), totalling 91 900.

Morrison (1997) reported an estimated 89 400 from five areas of the Canadian Arctic covering some 113 990 km^2, whereas Gill et al. (1999) reported 4900 from breeding areas in Alaska, for a breeding ground total of 94 300.

Pectoral Sandpiper *Calidris melanotos*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
PESA	400 000	400 000	400 000	400 000	77.1	500	83 800	63 400	B	Com

Little count information was available when Morrison et al. (1994a) suggested a preliminary estimate for the Canadian population of 25 000, and this figure is clearly much too low. The highest counts have been recorded in the lower U.S. states and Canada during fall migration, with totals approaching 150 000: eastern USA 62 200 (Harrington and Perry 1995), eastern Canada 1200 (MSS), Interior Flyway 83 800 (Skagen et al. 1999), and western North America 500 (G.W. Page, unpubl. data), totalling 147 700. The species is considered to be one of the most abundant migrants in the midwest United States, suggesting that an estimate for this region of at least 250 000 — i.e., well above the counted total — would be appropriate (S. Dinsmore, pers. commun.). Spring counts are lower and include eastern USA 28 700 (ISS), Interior Flyway 55 200 (Skagen et al. 1999), and Pacific USA 20 (ISS), totalling 83 920.

An estimated total of 279 100 was reported by Gill et al. (1999) for postbreeding numbers in Alaska; it is not known to what extent these birds may also be counted at sites farther south on the North American continent, as birds breeding in both the North American and Siberian Arctic are thought to migrate to wintering areas in South America (Holmes and Pitelka 1998) and are likely to pass through the central regions of the continent. Morrison (1997) reported an estimated total of 76 400 from four areas of the Canadian Arctic breeding grounds covering some 85 820 km^2, and a further 125 300 birds were reported from breeding areas in Alaska (Gill et al. 1999), bringing the total from the breeding areas covered to 201 700. Combining the Alaska postbreeding estimate (279 100) with the (minimum) estimate from the Canadian breeding grounds (76 400) provides a figure of 355 500 for areas where overlap in counting is not likely to occur. As not all areas of the breeding

grounds have been covered, the population is likely to be higher, possibly considerably higher, and an interim total of 400 000 is suggested.

Sharp-tailed Sandpiper *Calidris acuminata*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SHAS	166 000		3000	1000		1000				Unc

The global population of this species, which breeds in northern Siberia (Hayman et al. 1986), has been estimated on the Australasian wintering grounds as 166 000 (Watkins 1993; Rose and Scott 1997). Numbers found during migration periods are generally low. Gill et al. (1999) reported 2835 (most juveniles) from two sites in Alaska during the fall. The species occurs as an uncommon to fairly common transient along the coast of British Columbia (Campbell et al. 1990) between breeding grounds in Siberia and Australasia, in small groups of up to about 20. The suggested number using the North American/Canadian coasts south of Alaska is 1000.

Purple Sandpiper *Calidris maritima*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
PUSA	65 000		15 000	15 000	100			15 000	B	Com

This species has the most northerly wintering distribution of shorebirds occurring on the Atlantic coasts of North America and Europe. Birds from Canadian Arctic breeding areas may migrate to wintering areas in both North America and Europe; those from southern breeding grounds in the Canadian Arctic appear to migrate to wintering areas on the eastern seaboard of North America, and there is some evidence from banding recoveries that those from breeding areas farther north in the Canadian Arctic may move to wintering areas in Europe (Morrison 1984; Summers 1994). Relatively little information is available concerning the size of the population wintering on the east coasts of Canada and the United States. Morrison et al. (1994a) gave a tentative estimate of 10 000, but a somewhat higher total may be more appropriate, as combining maximum counts at all sites covered on Christmas Bird Counts in the eastern United States and Canada between 1966 and 1998 produces a total of 16 024 (K. Rosenberg, unpubl. data). We suggest an interim estimate of 15 000 for the North American population based on wintering counts; this does not include an estimate for birds from North American breeding areas that may migrate to Europe. The global population may then be estimated as 65 000, consisting of the 15 000 wintering in North America and an estimated 50 000 wintering in Europe (Smit and Piersma 1989; quoted as 50 500 by Rose and Scott [1997]).

Rock Sandpiper *Calidris ptilocnemis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
ROSA	200 000		150 000	1000s?						Com

Relatively little information is available for this species outside Alaska, and the provisional estimate of 10 000 suggested by Morrison et al. (1994a) would appear to be much too low. There are four recognized races of the Rock Sandpiper: *C. p. ptilocnemis*, the nominate form, which breeds on the Pribilof Islands, *C. p. tschuktschorum*, which breeds in east Siberia and west Alaska, *C. p. couesi*, which breeds on the Aleutian Islands and in south Alaska, and *C. p. quarta*, which breeds on the Commander and Kuril islands (Hayman et al. 1986).

The figure of 150 000 is suggested for the number of birds occupying North American breeding grounds, based on the following estimates: (1) *C. p. ptilocnemis*: 25 000, counts at wintering sites in Cook Inlet (Gill et al. 1999; R.E. Gill, unpubl. data), (2) *C. p. tschuktschorum*: 50 000, counts at various autumn staging sites (Gill et al. 1999; R.E. Gill, unpubl. data), (3) *C. p. couesi*: 75 000, counts at autumn staging areas in western Alaska (R.E. Gill, unpubl. data), totalling 150 000. Note that this does not include an estimate for *C. p. quarta* or specifically for those *C. p. tschuktschorum* breeding in Chukotka, although an unknown portion of the latter population, which has been estimated as 10 000–20 000 birds (P. Tomkovitch, pers. commun.), may move to the Alaskan coast in winter. When these populations are included, the global population of the Rock Sandpiper may reach as high as 200 000.

The species occurs year-round in Alaska. Numbers from potential WHSRN sites in Alaska, which form part of the basis for the above population estimate, are as follows. The largest recorded numbers occur in fall (84 000 from six sites), with lower numbers in spring (18 900 from three sites); numbers reported from the breeding season (37 500 from three sites) and from winter (35 400 from two sites) are intermediate (Gill et al. 1999). South of Alaska, numbers are much lower. In British Columbia, it is one of the more regularly seen uncommon calidridines, occurring typically in flocks of up to 50, with an all-time Canadian high count of 161 in December 1984 (Campbell et al. 1990). Records extending south to northern California probably involve the race *C. p. tschuktschorum* (Campbell et al. 1990).

Dunlin *Calidris alpina*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
DUNL	3 934 000+		1 525 000	775 000	65.8	517 500	91 900	138 300	B	Com

Nine global populations are listed by Rose and Scott (1997), with estimates for all but the population breeding in western North America (*C. a. pacifica*) totalling more than 3.1 million birds. Three subspecies occur in North America: *C. a. arcticola*, *C. a. hudsonia*, and *C. a. pacifica* (Warnock and Gill 1996). *Calidris a. arcticola* breeds in northern Alaska and is unlikely to reach Canada; there has been considerable discussion as to whether this subspecies may be referable to *C. a. sakhalina* breeding in eastern Siberia or even *C. a. pacifica* (see Warnock and Gill 1996). *Calidris a. hudsonia* and *C. a. pacifica* occur in central/eastern and Pacific regions, respectively. Provisional population estimates for these subspecies are suggested as follows (Warnock and Gill 1996; R.E. Gill, unpubl. data): *C. a. pacifica* 550 000 (500 000–600 000) (Page and Gill 1994; Warnock and Gill 1996; Bishop et al. 2000); *C. a. arcticola* (birds breeding along northern Alaska) 750 000 (based on extrapolations of breeding densities in northern Alaska; D. Troy, pers. commun.) (range quoted by Rose and Scott [1997] as C/D, 25 000–100 000/100 000–1 000 000); *C. a. hudsonia* 225 000 (150 000–300 000) (range D, 100 000–1 000 000, in Rose and Scott [1997]; see also counts below), totalling 1 525 000 (range 1 400 000–1 650 000). This would bring the global population total to 3 934 000+, with North American populations ranging up to 1 525 000. As all but the *C. a. arcticola* populations are likely to pass through Canada, the Canadian population may be estimated as 775 000.

Fall, spring, and winter counts in the Western Hemisphere flyways all produce totals in the range 300 000–600 000 birds, with fall counts in Alaska over 500 000. Fall totals include eastern USA 132 000 (ISS), east coast Canada 6300 (MSS), central USA 50 000 (Harrington and Page 1992), Pacific USA 41 000 (ISS), and British Columbia 109 000 (Morrison et al. 1995), totalling 338 300. Fall counts from 19 sites in Alaska totalled 517 500 (Gill et al. 1999), which, if substituted for the numbers (subsequently) found on the Pacific coast of Canada and the United States, would produce a fall total of 705 800. Spring counts include eastern USA 128 900 (ISS), Interior Flyway 91 900 (Skagen et al. 1999), and Pacific USA 120 000 (Harrington and Perry 1995), totalling 340 800; Gill et al. (1999) reported counts totalling 92 600 from seven sites in spring in Alaska, and Bishop et al. (2000) estimated an average of 550 000 ± 228 000 (SD) passing through the Copper River delta over four springs. Winter totals include 81 500 eastern USA (Harrington and Page 1992), mid USA 67 500 (Harrington and Page 1992), and western North America, including Canada, USA, and Baja California, 460 000 (G.W. Page, unpubl. data), for a total of 609 000, of which some 460 000 occurred on the Pacific coast. Less information is available from the breeding grounds. Estimates from three sites in west and west-central Alaska totalled 187 000 birds (Gill et al. 1999) and presumably involved the race *C. a. pacifica*. An estimated 13 100 birds occurred in two areas of the Canadian Arctic, as reported by Morrison (1997), and presumably involved the race *C. a. hudsonia*.

Stilt Sandpiper *Calidris himantopus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
STSA	200 000	200 000	200 000	200 000	80.5	10	149 300	32 350	B	Com

The estimate of 50 000+ previously suggested by Morrison et al. (1994a) is probably low, although Klima and Jehl (1998) considered it reasonable. However, spring and fall counts in North America total some 150 000 birds, and a population of about 200 000 may be more accurate. Autumn counts include eastern USA 32 300 (Harrington and Perry 1995), eastern Canada 50 (rounded) (MSS), Interior Flyway 120 500 (Skagen et al. 1999), Pacific USA 10 (rounded) (ISS), and Alaska 3200 (Gill et al. 1999), totalling 156 100. Spring counts include eastern USA 8800 (ISS), Interior Flyway 149 300 (Skagen et al. 1999), and Pacific USA 1 (ISS), for a total of 158 101. Spaans (1978) estimated that 10 000–50 000 passed through the coast of Suriname on migration. The total for sites in five countries in South America listed by Scott and Carbonell (1986) was 14 700. Information from the breeding grounds is limited and includes estimates of 5500 from one site in Alaska (Gill et al. 1999) and of 5300 from two areas of the Canadian Arctic (Morrison 1997).

Buff-breasted Sandpiper *Tryngites subruficollis*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
BBSA	15 000	15 000	15 000	15 000	86.7	30	6100	590	B	Reg

Morrison et al. (1994a) initially suggested a population estimate of 5000–10 000(+); this (midpoint 7500) is probably too low and could be increased somewhat on the basis of the species being quite easy to find in the midwest United States on migration (S. Dinsmore, pers. commun.) and counts from breeding areas. Lanctot and Laredo (1994) reported that numbers are highest in North America (south of Alaska) on the Interior Flyway, often during spring migration. Totals of highest

counts during spring include eastern USA 321 (ISS), Interior Flyway 6142 (Skagen et al. 1999, with revisions from Lanctot and Laredo [1994] for Beaverhill Lake, Alberta, and Saskatchewan [net increase of 3300 birds]), and Pacific USA 0 (ISS), for a total of 6463. Fall totals include eastern USA 553 (ISS), eastern Canada 33 (MSS), Interior Flyway 3747 (Skagen et al. 1999), Pacific USA 29 (ISS), and Alaska 5200 (Gill et al. 1999), totalling 9562. On the breeding grounds in the Canadian Arctic, 6560 birds were estimated in two breeding areas covering some 73 560 km^2 (Morrison 1997), and 14 000 were estimated to breed in the Northeast Alaska Lagoons (Gill et al. 1999), for a total of 20 560. On the wintering grounds, up to 2000 were considered to be present at one *estancia* in Argentina in Buenos Aires Province (Myers 1980), and Blanco et al. (1993) reported 899 on over 11 500 km of (mostly road) surveys in Uruguay and Argentina. Counts during more recent wintering ground surveys in Argentina, Uruguay, and southern Brazil (December 1999) totalled 1800 birds, and associated remote sensing/geographic information system (GIS) studies have suggested a more restricted wintering range than previously thought (R.B. Lanctot, pers. commun.). Given the relative perceived scarcity of the species, its tendency to occur in small concentrations, uncertainties concerning extrapolations on the breeding grounds (for a species that tends to form "exploded leks"; Myers 1979; Lanctot and Laredo 1994), and the fact that its wintering range may be smaller than previously thought, it would appear appropriate to adopt a conservative population estimate of some 15 000 (range 15 000–20 000) birds.

Short-billed Dowitcher *Limnodromus griseus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
SBDO	320 000		320 000	320 000	92.3	150 000	60 000	112 300	B	Com

The initial estimate of 100 000+ suggested by Morrison et al. (1994a) is probably rather low and can be increased to 320 000 on the basis of totals from wintering areas of some 264 500 and consideration of the likely subspecies involved. Three subspecies breed in North America: the nominate *L. g. griseus*, which breeds in eastern Canada (northern Quebec) and winters in Central America and South America, *L. g. hendersoni*, which breeds in central Canada west of Hudson Bay and winters on the Atlantic and Gulf coasts, and *L. g. caurinus*, which breeds in southern Alaska and winters along the Pacific coast from California into South America (Cramp and Simmons 1983; Godfrey 1986; Hayman et al. 1986).

Wintering ground totals include South America 192 100 (replacing the 21 800 for Suriname given by Morrison and Ross [1989] with 165 000 from estimates listed for this country by Scott and Carbonell [1986]), Panama 3100 (Morrison et al. 1998), and Mexico 69 300 (Morrison et al. 1994c), totalling 264 500. Numbers seen during migration are somewhat lower, although still substantial. Fall totals include eastern USA 68 700 (ISS), eastern Canada 38 600 (MSS), Quebec 5000 (Y. Aubrey, pers. commun.), central USA 60 000 (Harrington and Page 1992), Pacific USA 1850 (ISS), and Alaska 6100 (Gill et al. 1999), totalling 180 250. Spring totals include eastern USA 32 500 (ISS), Interior Flyway 55 000 (Harrington and Page 1992), and western North America 150 000 (G.W. Page, unpubl. data), for a total of 237 500. Spring counts in Alaska, which probably involve birds already counted farther south, total 3250 (Gill et al. 1999). Consideration of the above numbers and the likely migration routes of the subspecies leads to the following minimum estimates for each of the groups. The highest seasonal total for the west coast (spring) is 150 000, which would involve *L. g. caurinus*. Short-billed Dowitchers passing through central areas in the fall are likely to consist of *L. g. hendersoni*, indicating 60 000 as a minimum estimate for this population. Dowitchers passing through the east coast of the United States and Canada during the fall are likely to belong to the eastern population of *L. g. griseus*, indicating a minimum total of 68 700 + 38 600 = 107 300, or approximately

110 000 (perhaps larger when numbers occurring along the north coast of South America are considered). The minimum estimates for the three groups therefore total 320 000.

Note that these numbers are likely to be conservative, given that dowitchers are often reported in a general category in surveys where it may not be possible to distinguish between Short-billed Dowitchers and Long-billed Dowitchers.

Long-billed Dowitcher *Limnodromus scolopaceus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
LBDO	500 000		500 000	500 000	43.4	200 000	290 800	11 300	B	Reg

Long-billed Dowitchers are apparently rather more abundant than Short-billed Dowitchers and certainly more numerous than the figure of 50 000+ previously suggested by Morrison et al. (1994a) and referred to by Rose and Scott (1997). The estimate may be increased to 500 000 on the basis of counts made during spring migration in North America. Spring totals may be estimated as follows: eastern USA 3100 (ISS), western North America, including interior sites, 200 000 (G.W. Page, unpubl. data), and other central and Interior Flyway sites 290 800 (Skagen et al. 1999), for a total of 493 900. Reported fall numbers are somewhat lower: eastern USA 5700 (ISS), eastern Canada 5 (MSS), Interior Flyway 162 100 (Harrington and Page 1992), Pacific USA 17 000+ (Page et al. 1992), and Alaska 18 500 (Gill et al. 1999), totalling 203 305+. Winter numbers have been recorded as follows: eastern USA 11 300 (Harrington and Perry 1985), central USA 100 000 (Harrington and Page 1992), and California, at least 31 000 (Page et al. 1992), totalling 142 300. Numbers from the North American part of the breeding range (northwestern Alaska and northwest Canada), which extends well into the Siberian Arctic (Hayman et al. 1986), include 143 900 from two sites in north and west Alaska (Gill et al. 1999) and 624 from the Mackenzie Delta area in the Canadian Arctic (Morrison 1997) (breeding total 144 520). Most of the population is likely to pass through Canada on its way to the wintering grounds in the western and southern United States and Central America.

Common Snipe *Gallinago gallinago*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
COSN	26 750 000		2 000 000	2 000 000		120	67 700	52 200	B	Com

Rose and Scott (1997) listed six global populations, with estimates for five (all but the North American population) probably exceeding 24.75 million. The species is not likely to be well covered by many shorebird survey operations, owing to its secretive behaviour (Richards 1988) and habitat use. Numbers reported in North America for fall migration include eastern USA 52 000 (Harrington and Perry 1995), eastern Canada 165 (MSS), Interior Flyway 67 700 (Harrington and Page 1992), and Pacific USA 120 (ISS), for a total of some 120 000. Spring counts include eastern USA 50 100 (Harrington and Perry 1995), Interior Flyway 66 500 (Harrington and Page 1992), and Pacific USA 100 (ISS), totalling 116 700. In Quebec, at least 6000 is considered to be a minimal estimate of breeding birds, and harvest estimates for this species range up to 47 000 (Gauthier and Aubrey 1996; Y. Aubrey, pers. commun.). Calculations of population size using densities recorded on BBS routes and areas of physiographic strata from either BBS or Partners in Flight data result in estimates of 830 000–3 140 000 (R.I.G. Morrison, unpubl. data). Given the uncertainties involved and the

difficulties in assessing population size, we suggest adopting an population estimate of 2 million (range 1–3 million). This would bring the estimate for the global population to 26.75 million.

American Woodcock *Scolopax minor*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
AMWO	5 000 000		5 000 000	1 000 000		20	5000	56 000	B	Com

Little information is available, as this species tends to be dispersed and not covered adequately by most survey operations. Counts reported in North America include the following: fall — eastern USA 5010 (Harrington and Perry 1995), central USA 5000 (Harrington and Page 1992), and Pacific USA 20 (ISS), totalling 10 030: spring — eastern USA 5000 (Harrington and Perry 1995), central USA 5000 (Harrington and Page 1992), and Pacific 0 (ISS), totalling 10 000; and winter — eastern USA 26 600 (Harrington and Page 1992). The total population must be considerably larger, as Keppie and Whiting (1994) reported that perhaps as many as 2 million were shot annually in the United States and nearly 86 000 in Canada, indicating that the population might be in the 5 million range. The harvest in Quebec has been estimated to range up to 56 000 birds (Gauthier and Aubrey 1996). The species' behaviour renders it unsuitable for using BBS data for calculating population size (an estimate of approximately 5000 is obtained; R.I.G. Morrison, unpubl. data).

Wilson's Phalarope *Phalaropus tricolor*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
WIPH	1 500 000	1 500 000	1 500 000	680 000	45.3	82 500	827 100	830	B	Com

The initial estimate of 100 000+ suggested by Morrison et al. (1994a), as quoted in Rose and Scott (1997), appears to be much too low. Jehl (1988) (see also Colwell and Jehl 1994; Page and Gill 1994) provided an estimate for continental North America of 1.5 million, which is consistent with counts at migration areas in North America, which approach 1 million. Fall flyway counts total over 910 000 birds: eastern USA 800 (ISS), eastern Canada 26 (MSS), Interior Flyway 827 100 (Skagen et al. 1999), and Pacific USA 82 500 (Harrington and Perry 1995), totalling 910 400. Spring counts are lower, although still substantial in the interior: eastern USA 500 (Harrington and Perry 1995), Interior Flyway 392 300 (Skagen et al. 1999), and Pacific USA 855 (ISS), totalling 393 700. On the wintering grounds, Scott and Carbonell (1986) reported counts totalling 569 700 from sites at three countries in South America, including 500 000 at Laguna Mar Chiquita, Argentina.

Numbers occurring in Canada are expected to be lower than those in the United States, as breeding grounds used by the species in the United States are south of Canada. On the basis of Canada containing 45.3% of the breeding range, the estimated Canadian population would be 680 000.

Red-necked Phalarope *Phalaropus lobatus*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
RNPH	4 000 000		2 500 000	2 500 000	74.3	83 200	348 200	2 000 000	B	Com

Two global populations are listed by Rose and Scott (1997), with the Eurasian one estimated at 1 500 000 (range D/E: 100 000–1 000 000/>1 000 000) and the Nearctic one at >2 000 000 (Morrison et al. 1994a). The North American population should probably be adjusted to 2 500 000 on the basis of historical counts, although significant uncertainty exists about the current status of this population. The estimate is based on fall counts, including eastern Canada 2 000 000 (see Morrison et al. 1995) (this number would be large enough to include smaller numbers reported in MSS counts [2400] and ISS counts [sum 1000; Harrington and Page 1992]), Interior Flyway 348 200 (consisting of 48 200 reported by Skagen et al. [1999] to which may be added 300 000 reported at Great Salt Lake by Page et al. [1992]), Pacific USA 63 200 (Harrington and Perry 1995), Pacific Canada 20 000 (see Morrison et al. 1995), and Alaska 92 900 (Gill et al. 1999), for a total of 2 524 300. Numbers off eastern Canada appear to have declined drastically in recent years, and it is not known whether the birds have moved elsewhere or whether the population may have declined (see Morrison et al. 1995). Determination of the current status of the species is a pressing conservation requirement. Spring counts are generally lower: eastern USA 85 (ISS), Interior Flyway 225 442 (Skagen et al. 1999), and Pacific USA 1920 (ISS), for a total of 227 400.

Limited information is available from the breeding grounds. In Alaska, Gill et al. (1999) reported an estimated 670 500 birds from four sites between northern and western Alaska, and Morrison (1997) listed an estimated population of 63 700 from four areas covering 14 815 km^2 in the Canadian Arctic, for a breeding grounds total of 734 200.

Red Phalarope *Phalaropus fulicaria*

	Population estimates				% North American range in Canada	Current maximum count totals			Breeding status (Canada)	Abundance status (Canada)
Code	Global	Neotropical	North America	Canada		Pacific Flyway	Interior Flyway	Eastern Flyway		
REPH	1 000 000		1 000 000	920 000	91.8			100 400	B	Com

Relatively little information is available for this species, as it occurs mostly offshore and is not often recorded on shorebird surveys. Morrison et al. (1994a) suggested an estimate of 100 000–1 000 000, similar to the range indicated by R. Schlatter (pers. commun., cited in Rose and Scott 1997) for the population wintering off the Pacific coast of southern South America (range C/D: 25 000–100 000/100 000–1 000 000). Fall counts include 100 300 in eastern Canada (MSS), 100 in Quebec (Y. Aubrey, pers. commun.), and 34 500 from Alaska (Gill et al. 1999), totalling 134 900. Estimates of numbers in six breeding areas covering some 123 940 km^2 in Arctic Canada totalled 623 800 (Morrison 1997), and a further 101 000 were reported from two sites in Alaska (Gill et al. 1999), bringing the total from breeding areas to 724 800. It would appear likely the population is at least 1 million, possibly (considerably) more. The Canadian population is probably somewhat lower than the overall North American population, as birds breeding in northern Alaska may not necessarily migrate south through Canada; if numbers found in Canada are proportional to the percentage of the breeding range occurring in Canada (91.8%), the Canadian population would be 920 000.

Additional species

The following species have been recorded breeding in very small numbers in North America, as indicated below (R.E. Gill, unpubl. data):

Species	Scientific name	Global population	Notes on numbers in North America[a]
Grey-tailed Tattler	*Tringa brevipes*	25 000–100 000[b,c]	One confirmed breeding record in Alaska
Red-necked Stint	*Calidris ruficollis*	471 000[d]	A few dozen breed in Alaska
Curlew Sandpiper	*Calidris ferruginea*	250 000[d]	A few dozen breed in Alaska
Ruff	*Philomachus pugnax*	25 000–100 000[b,c]	A few dozen breed in Alaska

[a] R.E. Gill (unpubl. data).
[b] Rose and Scott (1997).
[c] Perennou et al. (1994).
[d] Watkins (1993, and pers. commun.).

4. Results, overview, and discussion

Current estimates of the population sizes of 53 species of shorebirds occurring in North America (plus four occasionally breeding species) are summarized in Table 1, with an assessment of the likely accuracies of the counts. The population estimates ranged from a few tens to several millions (Tables 1 and 2). Overall, the population estimates for the 53 regularly occurring species most commonly fell in the range of hundreds of thousands, particularly the low hundreds of thousands. Estimated population sizes for large shorebird species currently all fall below 500 000, and smaller species tend to have larger populations; the proportion of populations over 100 000 is 10/12 (83.3%) for small, 19/28 (67.9%) for medium-sized, and 4/13 (30.8%) for large species (Table 2). However, if mass (taken principally from Dunning [1984]) is taken as a measure of size, then a log–log plot of population size against mass (log transformation resulted in normalization of the data for both variables [excluding data for Eskimo Curlew; Shapiro-Wilk W test]) reveals a statistically significant negative relationship between population size and mass (Fig. 1(a); log(population size) = 16.479 –1.030*log(mass [g]), $r = -0.41$, $r^2 = 0.170$, $p = 0.002$, $n = 53$). The biological factors influencing population size are likely to be complex (Ricklefs 1973), and a discussion of the reasons for population size and mass being so closely related in the shorebird species being considered is outside the scope of the present paper. A number of features of the graph, however, are of particular interest. In addition to the main bundle of points lying along the regression line, two groups of outlying points may be distinguished: (1) a group of 10 species below the line (SNPL, SOSA, BBSA, PIPL, WIPL, PUSA, MOUP, WATA, HAST, ESCU), and (2) two outlying points above the line (COSN, AMWO). The species below the line, whose populations are generally lower than those of others of similar mass, include two broad categories of shorebirds:

- *Species at risk.* This group contains five of the six species considered to be "at risk" in Canada and the United States, including Eskimo Curlew (ESCU), Mountain Plover (MOUP), Snowy Plover (SNPL), Piping Plover (PIPL), and Hawaiian Stilt (HAST) (the sixth species, Long-billed Curlew [LBCU], falls on the line). The position of these five species below the regression line might suggest that their populations could be either depressed or underestimated; however, as these species have in many cases been the subject of specialized counts or investigations, it would appear likely that the populations are depressed rather than poorly counted.
- *Difficult-to-count species.* The other species in the group below the regression line include Solitary Sandpiper (SOSA), Buff-breasted Sandpiper (BBSA), Wilson's Plover (WIPL), Purple Sandpiper (PUSA), and Wandering Tattler (WATA). These are all species that tend to either be dispersed (SOSA) or occur in upland (BBSA), beach (WIPL), or rocky habitats (PUSA, WATA) and that are often poorly studied; these are all situations in which it is difficult to obtain shorebird counts over extensive areas, suggesting that the population estimates may be too low.

The two outliers above the regression line, Common Snipe (COSN) and American Woodcock (AMWO), are both cryptic species that are difficult to count and observe and whose estimates have

Table 1
Sizes, ranges, and likely accuracy of North American shorebird population estimates

Code	Species	Scientific name	Estimated population: North America	Estimated population: Canada	Range, notes	Accuracy rating[a]
BBPL	Black-bellied Plover	*Pluvialis squatarola*	200 000	200 000	>140 000	2
AGPL	American Golden-Plover	*Pluvialis dominicus*	150 000+	150 000+	breeding >134 000	2
PGPL	Pacific Golden-Plover	*Pluvialis fulva*	16 000		global at least 90 000	2
SNPL	Snowy Plover	*Charadrius alexandrinus*	16 000		16 000–21 000, ± 50%?	4
WIPL	Wilson's Plover	*Charadrius wilsonia*	6 000		5000–6000, ± 25%?	2
CRPL	Common Ringed Plover	*Charadrius hiaticula*	<10 000?	<10 000?	1000–10 000?; total population 195 000	1
SEPL	Semipalmated Plover	*Charadrius semipalmatus*	150 000	150 000	>124 000, ± 50%?	2
PIPL	Piping Plover	*Charadrius melodus*	5 913	2 110	census, ± 10%?	5
KILL	Killdeer	*Charadrius vociferus*	1 000 000	366 000	200 000–2 000 000	2
MOUP	Mountain Plover	*Charadrius montanus*	9 000	10	7500–10 000, ± 25%	4
AMOY	American Oystercatcher	*Haematopus palliatus*	8 850	4	3000–4000	3
BLOY	Black Oystercatcher	*Haematopus bachmani*	8 900	8 000	6900–10 800, ± 50%	3
BNST	Black-necked Stilt	*Himantopus mexicanus mexicanus*	150 000	400	>141 000	2
HAST	Hawaiian Stilt	*Himantopus mexicanus knudseni*	1 650		1500–1800	5
AMAV	American Avocet	*Recurvirostra americana*	450 000	63 000	300 000–500 000, ± 25%?	3
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	100 000	100 000	>83 000, ± 50%?	2
LEYE	Lesser Yellowlegs	*Tringa flavipes*	500 000	500 000	300 000–800 000, ± 25%?	2
SOSA	Solitary Sandpiper	*Tringa solitaria*	25 000	25 000	25 000–150 000	1
WILL	Willet	*Catoptrophorus semipalmatus*	250 000	25 000	>245 000	2
WATA	Wandering Tattler	*Heteroscelus incanus*	10 000	5 000	10 000–25 000?, ± 25%?	1
SPSA	Spotted Sandpiper	*Actitis macularia*	150 000	113 000	50 000–250 000	1
UPSA	Upland Sandpiper	*Bartramia longicauda*	350 000	10 000?	350 000–2 000 000	2
ESCU	Eskimo Curlew	*Numenius borealis*	<50	<50	0–50	1
WHIM	Whimbrel	*Numenius phaeopus*	57 000	57 000	25 000–100 000	2
BTCU	Bristle-thighed Curlew	*Numenius tahitiensis*	10 000		7500–11 800	4
LBCU	Long-billed Curlew	*Numenius americana*	20 000	1000s?	15 000–20 000	3
HUGO	Hudsonian Godwit	*Limosa haemastica*	50 000	50 000	>46 000	3
BTGO	Bar-tailed Godwit	*Limosa lapponica*	100 000		± 10–25%??	3
MAGO	Marbled Godwit	*Limosa fedoa*	171 500	103 000	141 000–202 000, ± 25%?	3
RUTU	Ruddy Turnstone	*Arenaria interpres*	235 000	235 000	± 30 000?	3
BLTU	Black Turnstone	*Arenaria melanocephala*	80 000	80 000	61 000–99 000	4
SURF	Surfbird	*Aphriza virgata*	70 000	70 000	50 000–100 000	3
REKN	Red Knot	*Calidris canutus*	400 000	256 000	± 25%?	3
SAND	Sanderling	*Calidris alba*	300 000	300 000	± 50%??	2
SESA	Semipalmated Sandpiper	*Calidris pusilla*	3 500 000	3 500 000	2 000 000–5 000 000	2
WESA	Western Sandpiper	*Calidris mauri*	3 500 000	3 500 000	2 800 000–4 300 000	4
LESA	Least Sandpiper	*Calidris minutilla*	600 000	600 000	± 50%??	1
WRSA	White-rumped Sandpiper	*Calidris fuscicollis*	400 000	400 000	± 25%??	3
BASA	Baird's Sandpiper	*Calidris bairdii*	300 000	300 000	140 000–300 000	3
PESA	Pectoral Sandpiper	*Calidris melanotos*	400 000	400 000	350 000–400 000	1
SHAS	Sharp-tailed Sandpiper	*Calidris acuminata*	3 000	1 000	166 000 global	1
PUSA	Purple Sandpiper	*Calidris maritima*	15 000	15 000	10 000–20 000	3
ROSA	Rock Sandpiper	*Calidris ptilocnemis*	150 000	1000s?	150 000–200 000	2
DUNL	Dunlin	*Calidris alpina*	1 525 000	775 000	1 400 000–1 650 000	2
STSA	Stilt Sandpiper	*Calidris himantopus*	200 000	200 000	50 000–200 000	2
BBSA	Buff-breasted Sandpiper	*Tryngites subruficollis*	15 000	15 000	15 000–20 000	2
SBDO	Short-billed Dowitcher	*Limnodromus griseus*	320 000	320 000	± 25–50%??	2
LBDO	Long-billed Dowitcher	*Limnodromus scolopaceus*	500 000	500 000	± 25–50%??	1
COSN	Common Snipe	*Gallinago gallinago*	2 000 000	2 000 000	1 000 000–3 000 000	1
AMWO	American Woodcock	*Scolopax minor*	5 000 000	1 000 000	± 25%??	2

Continued

Table 1
Sizes, ranges, and likely accuracy of North American shorebird population estimates

Code	Species	Scientific name	Estimated population: North America	Estimated population: Canada	Range, notes	Accuracy rating[a]
BBPL	Black-bellied Plover	*Pluvialis squatarola*	200 000	200 000	>140 000	2
AGPL	American Golden-Plover	*Pluvialis dominicus*	150 000+	150 000+	breeding >134 000	2
PGPL	Pacific Golden-Plover	*Pluvialis fulva*	16 000		global at least 90 000	2
SNPL	**Snowy Plover**	***Charadrius alexandrinus***	**16 000**		**16 000–21 000, ± 50%?**	**4**
WIPL	Wilson's Plover	*Charadrius wilsonia*	6 000		5000–6000, ± 25%?	2
CRPL	Common Ringed Plover	*Charadrius hiaticula*	<10 000?	<10 000?	1000–10 000?; total population 195 000	1
SEPL	Semipalmated Plover	*Charadrius semipalmatus*	150 000	150 000	>124 000, ± 50%?	2
PIPL	**Piping Plover**	***Charadrius melodus***	**5 913**	**2 110**	**census, ± 10%?**	**5**
KILL	Killdeer	*Charadrius vociferus*	1 000 000	366 000	200 000–2 000 000	2
MOUP	**Mountain Plover**	***Charadrius montanus***	**9 000**	**10**	**7500–10 000, ± 25%**	**4**
AMOY	American Oystercatcher	*Haematopus palliatus*	8 850	4	3000–4000	3
BLOY	Black Oystercatcher	*Haematopus bachmani*	8 900	8 000	6900–10 800, ± 50%	3
BNST	Black-necked Stilt	*Himantopus mexicanus mexicanus*	150 000	400	>141 000	2
HAST	**Hawaiian Stilt**	***Himantopus mexicanus knudseni***	**1 650**		**1500–1800**	**5**
AMAV	American Avocet	*Recurvirostra americana*	450 000	63 000	300 000–500 000, ± 25%?	3
GRYE	Greater Yellowlegs	*Tringa melanoleuca*	100 000	100 000	>83 000, ± 50%?	2
LEYE	Lesser Yellowlegs	*Tringa flavipes*	500 000	500 000	300 000–800 000, ± 25%?	2
SOSA	Solitary Sandpiper	*Tringa solitaria*	25 000	25 000	25 000–150 000	1
WILL	Willet	*Catoptrophorus semipalmatus*	250 000	25 000	>245 000	2
WATA	Wandering Tattler	*Heteroscelus incanus*	10 000	5 000	10 000–25 000?, ± 25%?	1
SPSA	Spotted Sandpiper	*Actitis macularia*	150 000	113 000	50 000–250 000	1
UPSA	Upland Sandpiper	*Bartramia longicauda*	350 000	10 000?	350 000–2 000 000	2
ESCU	**Eskimo Curlew**	***Numenius borealis***	**<50**	**<50**	**0–50**	**1**
WHIM	Whimbrel	*Numenius phaeopus*	57 000	57 000	25 000–100 000	2
BTCU	Bristle-thighed Curlew	*Numenius tahitiensis*	10 000		7500–11 800	4
LBCU	**Long-billed Curlew**	***Numenius americana***	**20 000**	**1000s?**	**15 000–20 000**	**3**
HUGO	Hudsonian Godwit	*Limosa haemastica*	50 000	50 000	>46 000	3
BTGO	Bar-tailed Godwit	*Limosa lapponica*	100 000		± 10–25%??	3
MAGO	Marbled Godwit	*Limosa fedoa*	171 500	103 000	141 000–202 000, ± 25%?	3
RUTU	Ruddy Turnstone	*Arenaria interpres*	235 000	235 000	± 30 000?	3
BLTU	Black Turnstone	*Arenaria melanocephala*	80 000	80 000	61 000–99 000	4
SURF	Surfbird	*Aphriza virgata*	70 000	70 000	50 000–100 000	3
REKN	Red Knot	*Calidris canutus*	400 000	256 000	± 25%?	3
SAND	Sanderling	*Calidris alba*	300 000	300 000	± 50%??	2
SESA	Semipalmated Sandpiper	*Calidris pusilla*	3 500 000	3 500 000	2 000 000–5 000 000	2
WESA	Western Sandpiper	*Calidris mauri*	3 500 000	3 500 000	2 800 000–4 300 000	4
LESA	Least Sandpiper	*Calidris minutilla*	600 000	600 000	± 50%??	1
WRSA	White-rumped Sandpiper	*Calidris fuscicollis*	400 000	400 000	± 25%??	3
BASA	Baird's Sandpiper	*Calidris bairdii*	300 000	300 000	140 000–300 000	3
PESA	Pectoral Sandpiper	*Calidris melanotos*	400 000	400 000	350 000–400 000	1
SHAS	Sharp-tailed Sandpiper	*Calidris acuminata*	3 000	1 000	166 000 global	1
PUSA	Purple Sandpiper	*Calidris maritima*	15 000	15 000	10 000–20 000	3
ROSA	Rock Sandpiper	*Calidris ptilocnemis*	150 000	1000s?	150 000–200 000	2
DUNL	Dunlin	*Calidris alpina*	1 525 000	775 000	1 400 000–1 650 000	2
STSA	Stilt Sandpiper	*Calidris himantopus*	200 000	200 000	50 000–200 000	2
BBSA	Buff-breasted Sandpiper	*Tryngites subruficollis*	15 000	15 000	15 000–20 000	2
SBDO	Short-billed Dowitcher	*Limnodromus griseus*	320 000	320 000	± 25–50%??	2
LBDO	Long-billed Dowitcher	*Limnodromus scolopaceus*	500 000	500 000	± 25–50%??	1
COSN	Common Snipe	*Gallinago gallinago*	2 000 000	2 000 000	1 000 000–3 000 000	1
AMWO	American Woodcock	*Scolopax minor*	5 000 000	1 000 000	± 25%??	2

Continued

Table 1 (*cont'd*)
Sizes, ranges, and likely accuracy of North American shorebird population estimates

Code	Species	Scientific name	Estimated population: North America	Estimated population: Canada	Range, notes	Accuracy rating[a]
WIPH	Wilson's Phalarope	*Phalaropus tricolor*	1 500 000	680 000	500 000–1 500 000	2
RNPH	Red-necked Phalarope	*Phalaropus lobatus*	2 500 000	2 500 000	1 000 000–3 000 000	1
REPH	Red Phalarope	*Phalaropus fulicaria*	1 000 000	920 000	1 000 000–2 500 000	1
Additional species						
GTTA	Grey-tailed Tattler	*Tringa brevipes*	2	0	global 25 000–100 000	
RNST	Red-necked Stint	*Calidris ruficollis*	<50	0	global 471 000	
CUSA	Curlew Sandpiper	*Calidris ferruginea*	<50	0	global 250 000	
RUFF	Ruff	*Philomachus pugnax*	<50	0?	regional 25 000–100 000	

[a] Population estimate accuracy classification:
1 (Poor): A population estimate based on an educated guess. Score 1 also given to ESCU, which has not been reliably seen in recent years.
2 (Low): A population estimate based on broad-scale surveys where estimated population size is likely to be in right order of magnitude.
3 (Moderate): A population estimate based on a special survey or on broad-scale surveys of a narrowly distributed species whose populations tend to concentrate to a high degree either a) in a restricted habitat or b) at a small number of favoured sites. Estimate thought to be within 50% of the true number.
4 (Good): A calculated estimate based on broad-scale mark:recapture ratios or other systematic estimating effort resulting in estimates on which confidence limits can be placed.
5 (High): Number obtained from a dedicated census effort and thought to be accurate and precise.

In some cases, an indication of the estimated % accuracy is also given in the Range, notes column. No accuracy rating is given for the four "Additional species" breeding in very small numbers in Alaska.

Shading indicates species that are considered "at risk" (i.e., endangered, threatened, vulnerable).

?, ?? indicate guesses, with increasing degree of uncertainty.

Table 2
Distribution of estimated population sizes of 53 species of shorebirds occurring in North America

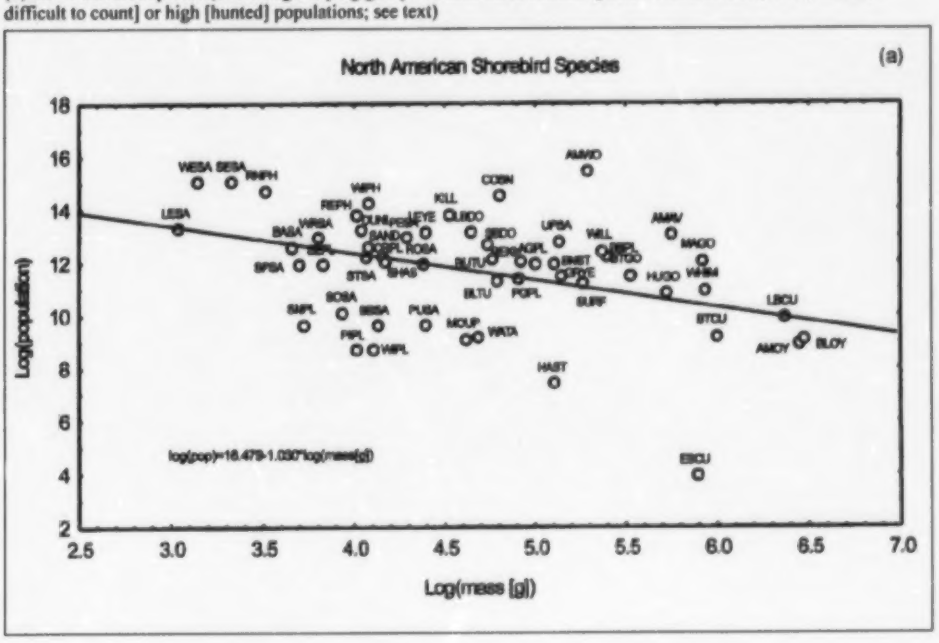
Population size	Species size: Small	Medium	Large	Total	%
10s			1	1	1.9
100s					
1000s	1	1	3	5	9.4
10 000–50 000	1	5	3	9	17.0
50 001–100 000		3	2	5	9.4
100 001–500 000	6	13	4	23	43.4
500 001–999 999	1	1		2	3.8
1 000 000+	3	3 (2)[a]		6 (2)	11.3 (3.8)
	12	26 (2)	13	51 (2)	

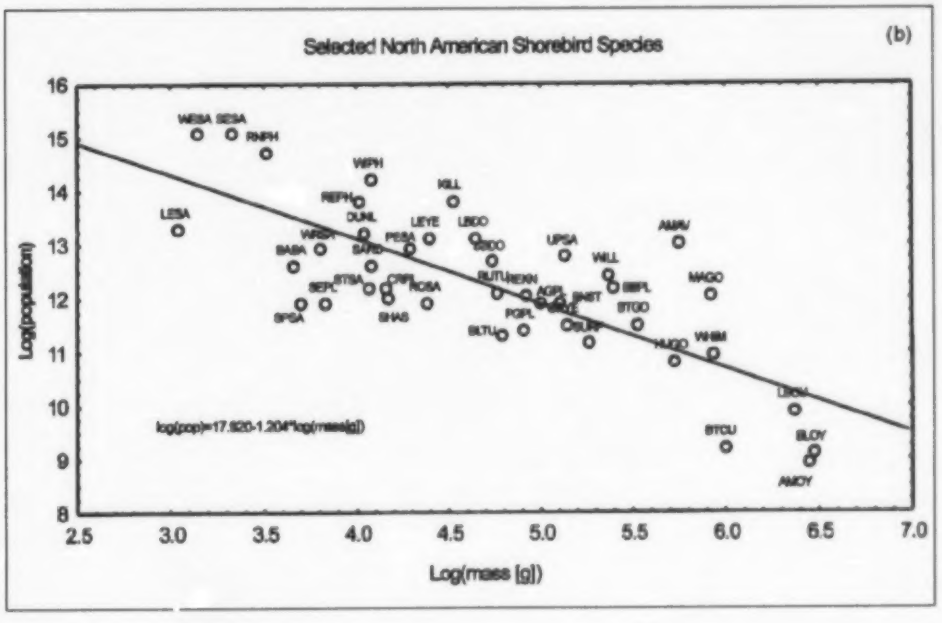
[a] Numbers in parentheses refer to Common Snipe and American Woodcock.

been derived from extrapolations that may be subject to large errors. These are also the only species in the shorebird group that are regularly hunted and are thus liable to different population pressures than the others.

As would be anticipated, removal of the outlying groups (on the basis of their populations being artificially low or high) results in an even closer relationship between population size and mass for the remaining species: log(population size) = 17.920 – 1.204*log(mass [g]), $r = 0.78$, $r^2 = 0.60$, $p = 0.0000$, $n = 41$ (Fig. 1(b)). Although the results suggest that the pattern of the regression may be interpreted meaningfully in identifying species whose populations are either artificially lower or higher than might be anticipated, use of the relationship for other purposes such as identifying potential target population levels for conservation would remain debatable, as the biological reasons underlying the observed relationship are not well understood at present.

Figure 1
Relationship between log(population size) and log(mass [g]) for shorebirds occurring in North America (a) for all 53 species occurring regularly in North America (includes Canada, United States, including Hawaii, and Mexico), and (b) for 41 selected species (excluding outlying groups considered to contain species with artificially low ["at risk," difficult to count] or high [hunted] populations; see text)


North American Shorebird Species
(a)
Log(population)
Log(mass [g])
log(pop)=16.479-1.030*log(mass[g])
WESA SESA RNPH WIPH REPH KILL COSN AMWO LESA WRSA DUNL PESA LEYE LBDO UPSA AMAV BASA SAND SBDO WILL MAGO SPSA STSA SHAS RUTU POPL BTGO HUDO WHIM SUSA SMPL SESA PUSA MOUP WATA SUSP LBCU BTCU AMOY BLOY HAST EBCU


Selected North American Shorebird Species
(b)
Log(population)
Log(mass [g])
log(pop)=17.920-1.204*log(mass[g])
WESA SESA RNPH WIPH REPH KILL LESA DUNL LEYE LBDO WRSA PESA SBDO UPSA AMAV BASA SAND WILL SESA STSA CRPL ROSA RUTU RKNN AGPL BBPL MAGO SPSA SHAS POPL BTGO BLTU HUDO WHIM LBCU BTCU BLOY AMOY

An indication of the likely accuracy of the population estimate for each species is given in Table 1. Likely accuracies are often difficult to assess, as estimates have been derived by a variety of methods using counts and survey information obtained at various times of the year and for which there is often no statistical assessment of likely error. Estimates range from those based on an educated guess to those that have been derived from a dedicated census effort that is likely to produce a relatively precise estimate. Even though a single number is given for each population, the broad range of many of the estimates emphasizes the need for considerable caution in using the estimates for conservation purposes, such as setting target levels for management of a species.

Many sources of error are associated with population estimates based on counts at migration areas. Use of maximum counts at a site will almost certainly underestimate the total number of birds using the site owing to the phenomenon of "turnover" as birds pass through the site. Turnover rates may be considerably different in different regions and at different times of the year. For instance, among small sandpipers, Semipalmated Sandpipers on the Atlantic coast of Canada are thought to have a turnover time of about 10–15 days in the Bay of Fundy during fall migration (Hicklin 1987), whereas Western Sandpipers on the Pacific coast of British Columbia are thought to have a turnover time of only 1–3 days during fall migration (Butler et al. 1987), leading to very different peak numbers occurring at the major sites during migration in the two areas. Turnover times for Western Sandpipers during spring migration are also generally less than 5 days (Iverson et al. 1996; Warnock and Bishop 1998). Turnover rates for several shorebird species on the Canadian Prairies were apparently longer in the fall (7–10 days) than in the spring (4–6 days) (Alexander and Gratto-Trevor 1997).

When a species visits more than one site in a region during migration, use of maximum counts at various sites leads to the possibility of birds being counted more than once. On the other hand, several aspects of shorebird migration are likely to lead to undercounting, including differential migration of age groups, peaks being missed when maximum numbers occur on days when counts were not conducted, sites not being counted, etc. These types of error are likely to vary considerably across species, seasons, and sites. When adults and juveniles pass through migration sites at different times, as is the case for many species during fall migration, peak counts are likely to refer to only one of the age groups. For some species that do not commence breeding until several years of age, the nonbreeding (mostly prebreeding) segment of the population may remain as a "summering" population on the wintering grounds or in areas well south of the breeding areas. Although these birds would be included in counts conducted at wintering sites, they would generally be missed in counts carried out at migration areas. Another obvious source of error is incomplete coverage of sites at which the species occurs, whether on migration or on wintering areas. In the case of birds passing through wetlands in the interior of the continent, the highly variable conditions that are found from year to year may lead birds to change sites between years, so that maximum counts at different sites may involve the same birds over a period of years and hence lead to inflated maximum count totals. On the other hand, many birds will not be counted at all, as coverage of sites is always substantially incomplete.

Counting errors at sites are rarely assessed. Stochastic errors occurring when counts of many flocks are added to obtain an overall total tend to balance out and may be in the order of 5–10% when many medium-sized flocks are counted, although they are potentially much higher when species occur in a few large flocks (Rappoldt et al. 1985). Errors resulting from missing flocks when high-tide roosts are counted are likely to exceed counting errors (Yates and Goss-Custard 1991). Errors involved in aerial survey counts are likely to be larger than those resulting from ground counts (Meltofte et al. 1994). Systematic errors are generally thought to lead to underestimates, rather than overestimates, when large numbers of birds are being counted (Meltofte et al. 1994).

Sources of error resulting from misidentification are likely to be small for many species whose plumage or size results in a distinctive appearance. For some species, however, it may not always be possible or practicable to distinguish between similar species, such as dowitchers (Short-billed and Long-billed) and yellowlegs (Lesser and Greater), especially if birds have to be viewed at a distance

or are being counted during aerial surveys. In the small sandpipers, it may be difficult to account for small numbers of species such as Least Sandpipers or Spotted Sandpipers occurring in very large flocks of more common species such as Semipalmated Sandpipers. Dispersed species, such as Solitary Sandpipers, are potentially more difficult to count, as they may occur in small numbers at many sites, in contrast to species that occur in large numbers at a restricted number of sites; however, if the bottlenecks are missed with species that concentrate, large errors will result. Cryptic species such as American Woodcocks present special problems, as illustrated by the data that show a seasonal high count of 26 000 but an estimated total population of some 5 million (Keppie and Whiting 1994).

Estimates that are most likely to be reasonably accurate are likely therefore to involve species that concentrate to a moderate or high degree on migration or wintering areas, where they are able to be counted in a fairly complete manner. The best estimates currently available may involve species such as the Red Knot and Semipalmated Sandpiper. For the Red Knot, combinations of wintering ground surveys and banding suggested a total of 100 000–150 000 (Harrington et al. 1988; Morrison and Ross 1989; Morrison and Harrington 1992), which is similar to the current estimate of 167 000 based on counts at migration areas, where the species is heavily concentrated during northward migration. Note, however, that some recent work has suggested that knot populations may have declined in recent years (Baker et al. 1999). For Semipalmated Sandpipers, aerial surveys of the main wintering grounds in South America as well as banding indicated a population in the order of 2–5 million (Spaans 1984; Morrison and Ross 1989), a figure compatible with numbers occurring in the Bay of Fundy during fall migration (Hicklin 1987). The much improved availability of information from central flyways has led to increases in the population estimates for a number of species, especially small sandpipers such as White-rumped Sandpiper and Baird's Sandpiper, where the current estimates in the hundreds of thousands are likely much closer to the actual population number than were previous estimates (Morrison et al. 1994a).

The few cases for which confidence limits or error estimates are available for population estimates usually come from studies on the breeding grounds, which often involve more formalized assessments than coastal surveys, but which may or may not cover the entire breeding range of the species involved (e.g., Black Turnstones in Alaska, Handel and Gill 1992; six species on Prince Charles Island, Nunavut, Morrison 1997; four species on the Rasmussen Lowlands, Nunavut, Gratto-Trevor et al. 1998). Remote sensing studies have been used successfully to identify and quantify areas of different breeding habitats in particular regions of the Arctic (Gratto-Trevor 1996; Morrison 1997), allowing extrapolated estimates of breeding populations over large areas; they may also enable modelling to be carried out to allow for effects such as variation in breeding densities with distance from coast and elimination of unsuitable patches of a habitat type where required combinations of other habitats are not present (Morrison 1997). Remote sensing studies may work well at a regional level in the Arctic, but it is unlikely that studies in one region could be extended to others without extensive ground-truthing operations over enormous regions, thus limiting the practicability of this method for assessing populations across the entire Arctic (Morrison 1997).

In cases where the sum of the highest counts across sites within one season formed the basis for making an estimate of the population size, the season at which this highest aggregated total occurred varied considerably across the 53 shorebird species considered (Table 3). Highest totals for just under half the species (25 of 53, 47%) were derived from counts made at migration areas, including both fall (13 species) and spring (12 species) staging/stopover sites. Highest counts or estimates for most of the remaining species (27 of 28) came from outside migration periods, involving wintering grounds (13 species) or breeding areas (14 species). Population estimates for one species were not related directly to counts from any particular part of the annual cycle and represent the current best guess — the species involved, the Wandering Tattler, occurs principally on rocky coastal habitats, which are often difficult to cover adequately during surveys.

When counts at migration areas only were considered, data for both spring and fall were available for 40 species, with 26 showing higher peaks in the fall and 14 showing higher peaks in the

Table 3
Summary of highest seasonal counts or estimates (see species accounts) for 53 species of shorebirds in North America

				Seasonal count (from species accounts)				Season of highest count					Ratio[c]	
Code	Species	Migration distance[a]	Size[b]	Breeding	Winter	Fall southward	Spring northward	No season	Breeding	Winter	Fall	Spring	F/S	S/F
BBPL	Black-bellied Plover	I	M	140 000	87 440	105 200	72 000	.	X	.	.	.	1.46	.
AGPL	American Golden-Plover	L	M	133 600	6 155	97 200	46 200	.	X	.	.	.	2.10	.
PGPL	Pacific Golden-Plover	L	M	.	125 000	15 900	.	.	.	X	.	.	.	.
SNPL	Snowy Plover	S	S	.	.	7 320	7 620	.	.	.	.	X	.	1.04
WIPL	Wilson's Plover	S	M	.	5 400	2 396	5 822	.	.	.	.	X	.	2.43
CORP	Common Ringed Plover	I	S	1000s	195 000	.	.	.	.	X	.	.	.	.
SEPL	Semipalmated Plover	I	S	.	48 600	124 400	41 800	.	.	.	X	.	2.98	.
PIPL	Piping Plover	S	S	5 913	.	.	.	.	X	.	.	.	.	.
KILL	Killdeer	S	M	1 000 000+	.	63 900	23 900	.	X	.	.	.	2.67	.
MOPL	Mountain Plover	S	M	.	9 000	2 497	1 334	.	.	X	.	.	1.87	.
AMOY	American Oystercatcher	S	L	3 390	.	3 271	838	.	X	.	.	.	3.90	.
BLOY	Black Oystercatcher	S	L	8 900	.	.	.	.	X	.	.	.	.	.
BNST	Black-necked Stilt	S	L	.	60 100	141 400	119 800	.	.	.	X	.	1.18	.
HAST	Hawaiian Stilt	S	L	1 650	.	.	.	.	X	.	.	.	.	.
AMAV	American Avocet	S	L	.	263 900	386 500	170 200	.	.	.	X	.	2.27	.
GRYE	Greater Yellowlegs	I	M	.	83 500	45 800	31 900	.	.	X	.	.	1.44	.
LEYE	Lesser Yellowlegs	I	M	.	296 700	217 000	99 800	.	.	X	.	.	2.17	.
SOSA	Solitary Sandpiper	I	M	.	3 000	2 800	6 100	.	.	.	.	X	.	2.18
WILL	Willet	S	L	.	245 400	92 000	36 400	.	.	X	.	.	2.53	.
WATA	Wandering Tattler	IL	M	.	.	(397)	.	X	.	.	.	.	.	.
SPSA	Spotted Sandpiper	I	S	5 000+	24 000	6 800	7 900	.	.	X	.	.	.	1.16
UPSA	Upland Sandpiper	I	M	350 000	25 000	3 840	5 100	.	X	.	.	.	.	1.33
ESCU	Eskimo Curlew	L	L	.	.	.	23	.	.	.	.	X	.	.
WHIM	Whimbrel	I	L	38 600	30 600	9 350	16 400	.	X	.	.	.	.	1.75
BTCU	Bristle-thighed Curlew	L	L	7 000	.	.	.	.	X	.	.	.	.	.
LBCU	Long-billed Curlew	S	L	.	1 945	14 130	5 460	.	.	.	X	.	2.59	.
HUGO	Hudsonian Godwit	L	L	36 000	46 000	20 630	17 700	.	.	X	.	.	1.17	.
BTGO	Bar-tailed Godwit	L	L	100 000	.	.	.	.	.	.	X	.	.	.
MAGO	Marbled Godwit	S	L	.	64 510	94 600	92 100	.	.	.	X	.	1.03	.
RUTU	Ruddy Turnstone[d]	L	M	86 900	46 720	23 900	159 600	.	.	.	.	X	.	6.68
BLTU	Black Turnstone	S	M	80 000	1 200	1 135	29 840	.	X	.	.	.	.	26.29
SURF	Surfbird	IL	M	.	.	.	70 000	.	.	.	.	X	.	.
REKN	Red Knot[e]	L	M	.	79 900	58 100	163 500	.	.	.	.	X	.	2.81
SAND	Sanderling	IL	S	136 800	260 100	265 900	203 500	.	.	.	.	X	1.31	.
SESA	Semipalmated Sandpiper	I	S	342 500	2 189 800	1 121 300	587 200	.	.	X	.	.	1.91	.

Continued

Table 3 (*cont'd*)
Summary of highest seasonal counts or estimates (see species accounts) for 53 species of shorebirds in North America

				Seasonal count (from species accounts)				Season of highest count					Ratio[c]	
Code	Species	Migration distance[a]	Size[b]	Breeding	Winter	Fall southward	Spring northward	No season	Breeding	Winter	Fall	Spring	F/S	S/F
WESA	Western Sandpiper	I	S	.	1 522 100	470 500	3 500 000	.	.	.	.	X	.	7.44
LESA	Least Sandpiper	I	S	.	141 000	494 600	210 300	.	.	.	X	.	2.35	.
WRSA	White-rumped Sandpiper	L	S	365 700	73 000	28 500	350 200	.	X	.	.	.	.	12.29
BASA	Baird's Sandpiper	L	S	94 300	.	91 900	143 520	.	.	.	.	X	.	1.56
PESA	Pectoral Sandpiper	L	M	201 700	.	279 100+	83 920	.	.	.	X	.	3.33	.
SHSA	Sharp-tailed Sandpiper	L	M	.	166 000	2 835	.	.	.	X	.	.	.	.
PUSA	Purple Sandpiper	S	M	.	16 024	.	.	.	.	X	.	.	.	.
ROSA	Rock Sandpiper	S	M	37 500	35 400	125 000	18 900	.	.	.	X	.	4.44	.
DUNL	Dunlin	I	M	.	609 000	705 800	340 800	.	.	.	X	.	2.07	.
STSA	Stilt Sandpiper	L	M	10 800	14 700	156 260	158 101	.	.	.	.	X	.	1.01
BBSA	Buff-breasted Sandpiper	L	M	20 660	2 899	9 562	6 463	.	X	.	.	.	1.48	.
SBDO	Short-billed Dowitcher	I	M	.	264 500	180 250	96 250	.	.	X	.	.	1.82	.
LBDO	Long-billed Dowitcher	SI	M	144 500	151 300	188 100	493 900	.	.	.	.	X	.	2.63
COSN	Common Snipe	S	M	.	.	120 000	116 700	.	.	.	X	.	1.03	.
AMWO	American Woodcock	S	M	.	26 600	10 030	10 000	.	.	X	.	.	1.00	.
WIPH	Wilson's Phalarope	IL	M	.	569 700	910 400	393 700	.	.	.	X	.	2.31	.
RNPH	Red-necked Phalarope	IL	S	734 200	.	2 523 600	227 400	.	.	.	X	.	11.10	.
REPH	Red Phalarope	L	M	724 800	.	134 800	.	.	X	.	.	.	.	.
	53							1	14	13	13	12		
												Mean	2.53	5.04
												SD	2.10	6.92
												n	26	14
												Min	1.00	1.01
												Max	11.10	26.29

[a] I = intermediate; L = long; S = short; IL = intermediate-long; SI = short-intermediate.
[b] S = small; M = medium-sized; L = large.
[c] F = fall; S = spring.
[d] *A. i. morinella.*
[e] *C. c. rufa.*

spring (Table 3). There did not appear to be any statistically significant tendency to concentrate disproportionately in one season or the other. Ratios of counts between the two seasons were generally similar in the two groups; for species with higher fall counts, the fall count was on average 2.53 ± 2.10 (SD) times higher than the spring count, ranging from about even (1.003) to some 11.1 times the spring count; for species with higher spring counts, the ratio averaged 5.04 ± 6.92 (SD) times the fall count, varying from about even (1.01) to some 26.3 times the fall count (Kruskal-Wallis ANOVA by ranks, $H(1,40) = 0.50$, $p = 0.48$, ns; median test $\chi^2 = 0.44$, $p = 0.51$) (Table 3).

Although species whose maximum counts were recorded in spring had the longest mean migration distances (latitudinal span between breeding and wintering areas), this mean was not significantly different from those found for species having maximum counts at other times of the year (means ± SD (n): spring 67.5 ± 35.9 (12), fall 42.5 ± 29.7 (12), breeding 55.3 ± 42.6 (15), wintering 57.3 ± 32.2 (13), ANOVA, $F = 0.98$, $p = 0.41$, data distributed normally within each group, Kolmogorov-Smirnov test, $p > 0.20$ in all cases). Long-distance migrants moving to wintering grounds in the southern parts of South America tend to gather in large numbers at staging sites in North America in the spring to replenish reserves depleted during flights from the southerly parts of the wintering range before the final stage of the migration to the breeding grounds. Long-distance migrants such as the Red Knot and Sanderling concentrate in large numbers at east coast sites in the United States (especially Delaware Bay), whereas species such as White-rumped Sandpiper and Baird's Sandpiper occur in large numbers in the Interior Flyway during spring migration. This concentration at spring "bottlenecks" may enable a substantial part of the population to be accessed for counting at a small number of places at one time.

There was no overall link between flocking characteristic (i.e., tendency of species to occur in flocks or to be dispersed) and the season (migration vs. nonmigration) at which highest counts were observed (Pearson $\chi^2 = 0.41$, 1 df, $p = 0.52$). Flocking species, however, did tend to migrate longer distances as estimated by the mean latitudinal span between breeding and wintering areas (means SD (n): flocking species 61.5 ± 35.2 (40) degrees, dispersed species 38.5 ± 31.8 (13) degrees, $t = 2.10$, $p = 0.04$, data within each group normally distributed, Kolmogorov-Smirnov test, $p > 0.20$ for both groups).

Size and migration distance were not related for small and medium-sized species, whereas there was a borderline tendency for large species to be shorter-distance migrants compared with medium-sized species (LSD test, $p = 0.08$; mean distances in degrees of latitude ± SD (n): small 58.9 ± 34.0 (14), medium-sized 61.9 ± 32.5 (26), large 40.4 ± 40.8 (13); data in each group normally distributed, Kolmogorov-Smirnof test, $p > 0.20$ for all groups).

A major use of population figures is in assessing the importance of a site for conservation, based on one of the percentage criteria used with the Ramsar Convention (1%) or WHSRN (5%, 15%, 30% for different site categories). Shorebird populations are dynamic, with the implication that monitoring and regular updating of population estimates are necessary if information used for conservation purposes is to be kept current. Wetlands International has adopted a 3-year update schedule for its population estimates for world waterbird populations, to coincide with the Meeting of the Conference of the Contracting Parties to the Ramsar Convention (Rose and Scott 1997). If large changes in numbers are detected, supporting research will be needed to identify causes; for instance, uncertainty exists about whether the huge decreases in numbers of Red-necked Phalaropes that have occurred in the Bay of Fundy over the past 25 years represent a true population crash or whether the birds may have moved elsewhere. Increasing evidence from many parts of North America suggests that a majority of shorebird populations are in decline (Howe et al. 1989; Morrison et al. 1994b; Page and Gill 1994; Harrington 1995), emphasizing the need for future monitoring of shorebird population numbers and trends.

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